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THE RISE OF THE POTTERY INDUSTRY.

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THE DEVELOPMENT OF AMERICAN INDUSTRIES SINCE COLUMBUS. X.

FOREIGN writers would have the world believe that the United States can boast of no ceramic history. Even our own chroniclers have, singularly enough, neglected a branch of our industrial progress which is not altogether insignificant nor devoid of interest. On the contrary, it can be shown that the fictile art is almost as ancient in this country as in Great Britain, and has been developed in almost parallel lines.

The first European settlers found the American natives proficient in the manufacture of earthen vessels, and we would not be justified in supposing, even in the absence of documentary evidence, that our ancestors were more ignorant of the useful arts than the Atlantic Coast Indians, who, less cultured than the prehistoric mound builders and the Pueblo races of the West, were in possession of rude, but often ornamental, utensils made of baked clay and sand.

Primitive potteries for the production of earthenware on a small scale were operated in the provinces at an early period, but as only the coarser grades of ware were needed by the simple inhabitants of a new country, no extended accounts of them appear to have been written by the older historians. As early as the year 1649, however, there were a number of small potteries in Virginia which carried on a thriving business in the communities in which they existed; and the first Dutch settlers in New York brought with them a practical knowledge of potting, and are said to have made a ware equal in quality to that produced in the ancient town of Delft. Prof. Isaac Broome, of the Beaver

Falls Art Tile Works, informs me that the remains of an old kiln fire-hole, saved from the ravages of time by being thoroughly vitrified, still exist a mile or two below South Amboy, N. J. This is a relic of the earlier pottery ware made on this continent, and was most probably established by the Dutch to make stew-pans and pots.

Dr. Daniel Coxe, of London, proprietor, and afterward governor, of West Jersey, was undoubtedly the first to make white ware on this side of the Atlantic. While he did not come to America himself, he caused a pottery to be erected at Burlington, N. J., previous to the year 1690, through his agent, John Tatham, who, with Daniel Coxe, his son, looked after his large interests here. It is recorded that in 1691 Dr. Coxe sold to the "West New Jersey Society" of London, consisting of forty-eight persons, his entire interests in the province, including a dwelling-house and "pottery-house" with all the tools, for the sum of £9,000 sterling. We are indebted to Mr John D. McCormick, of Trenton, N. J., for calling attention to the following reference to this pottery, supposed to have been written about 1688, in the Rawlinson manuscripts in the Bodleian Library at Oxford, England: "I have erected a pottery att Burlington for white and chiney ware, a greate quantity to ye value of £1200 have beene already made and vended in ye Country, neighbour Colonies and ye Islands of Barbadoes and Jamaica where they are in great request. I have two houses and kills with all necessary implements, diverse workemen, and other servants. Have expended thereon about £2000." * It is possible to gain some idea of the nature of this "white and chiney ware" by examining the statements of Dr. Plot, a contemporary, who published his Natural History of Staffordshire two years before, as quoted by the late Mr. Llewellynn Jewitt, in his Ceramic Art of Great Britain: "The greatest pottery they have in this country is carried on at Burslem, near Newcastle-under-Lyme, where for making their different sorts of pots they have as many different sorts of clay . . . . and are distinguish't by their colours and uses as followeth:—

"1. *Bottle clay*, of a bright whitish streaked yellow colour.

"2. *Hard fire clay*, of a duller whitish colour, and fully intersperst with a dark yellow, which they use for their *black wares*, being mixt with the

"3. *Red Blending clay*, which is of a dirty red colour.

"4. *White clay*, so called it seems, though of a blewish colour, and used for making yellow-colour'd ware, *because yellow is the lightest colour they make any ware of.*" †

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* MS. Rawlinson, c. 128, fol. 395.

† Page 97, vol. i, London, 1878.

In 1685 Thomas Miles made a white "stone-ware" of pipe-clay procured at Shelton. A few years after this, it is said that a potter named Astbury made "crouch" and "white stone" ware in the same town, on which he used a salt glaze.* It is probable that the "chiney" of the Burlington pottery was in reality a cream-colored ware or a white stone-ware somewhat similar to that made about the same time in England. It is not unlikely that the clay was brought from South Amboy, as Dr. Coxe owned considerable land in that vicinity. This clay has since been extensively employed in the manufacture of fine stone-ware.

Among the immigrants of the seventeenth century were potters who had learned their trade in the mother country, and Gabriel Thomas, who came from England, states in his Description of Philadelphia, published in 1697, that "great encouragements are given to tradesmen and others. . . . Potters have sixteen pence for an earthen pot which may be bought in England for four pence."

It has heretofore been generally believed that the first bricks used in the erection of houses in this country were imported, but it is more than probable that by far the greater proportion were made here. Daniel Pegg and others manufactured bricks in Philadelphia as early as 1685, and within a few years after that date numerous brick-yards were in operation along the shores of the Delaware. Many residences throughout the country, particularly in certain sections of Pennsylvania, were built of brick early in the eighteenth century. The cost of importing these supplies from England and transporting them to the rural districts, far removed from tide-water, would have been prohibitory. That building-bricks were extensively manufactured here previous to 1753 is indicated by a statement of Lewis Evans, of Philadelphia, who wrote to a friend in England in that year: "The greatest vein of Clay for Bricks and Pottery begins near Trenton Falls, and extends a mile or two in Breadth on the Pennsylvania side of the River to Christine; then it crosses the River and goes by Salem. *The whole world cannot afford better bricks than our town is built of.* Nor is the Lime which is mostly brought from White Marsh inferior to that wherewith the old castles in Britain were formerly built."

When burned, as formerly, in "clamps," the bricks formed their own kiln, piled on edge, a finger's breadth apart, to allow the heat to circulate between. Those which came in direct contact with the wood-fire in the kiln were blackened and partially vitrified on the exposed ends; while the opposite extremities,

* This was made of tobacco-pipe clay mixed with flint, and was superior to anything produced before.

which were farthest from the heat, were only partially burned, and consequently too soft for external use. The other bricks in the kiln which were uniformly surrounded by heat came out red. To utilize all the bricks produced, the black ends of the former were laid outward in the wall, thus combining utility with ornamentation. Many of the older houses were constructed in this manner. An old building on the Brandywine, near West Chester, erected in 1724, was built of bricks made on the property from clay found in the vicinity. The structure was considered an imposing one in its day, and the walls are still standing, in an excellent state of preservation. The annexed drawing will convey a good idea of the manner of laying the bricks in a wall where the red and black varieties were used, known as the Flem-

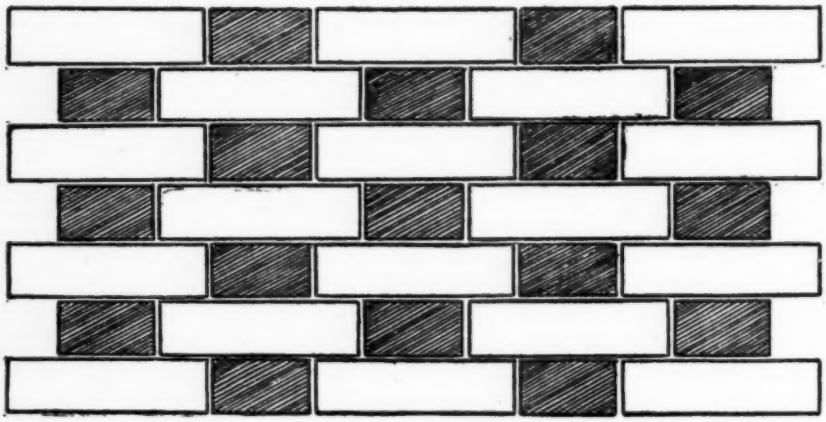


FIG. 1.—FLEMISH BOND.

ish bond, in which the binders and stretchers alternated, each layer breaking joints with that above and below.

Roofing tiles were also manufactured in this country more than a hundred years ago. Plain tiles were made of ordinary brick clay, about five eighths of an inch in thickness and six and a half to seven inches wide by thirteen to fourteen in length. They were fastened to the rafters of the roof by means of a clay knob or hook at the upper margin of the under side. The surfaces were broadly and shallowly grooved to carry the water off. Such tiles are still found in the *débris* of an old smithy which was built in 1799 at Cope's Bridge on the Brandywine. Other examples, made in Lancaster County, Pa., one of which bears the date 1769, have recently come to light.

A stone-ware factory was started in New York, at "Potter's Hill," near the "Fresh-water Pond," back of the City Hall, in or about 1735, by John Remmey, who came from Germany. The business passed through three generations, all of the same name,

and was discontinued about 1820. Later on, John Remmey, great-grandson of the above, moved to South Amboy, N. J., and established a pottery there.

Previous to the middle of the last century, and before the manufacture of porcelain had been attempted in America, English potters were using china clays procured in this country. Mr. Jewitt, in his Ceramic Art of Great Britain, informs us that a patent was taken out in 1744, by Edward Heylyn, of the parish of Bow, in the county of Middlesex, merchant, and Thomas Frye, of the parish of West Ham, in the county of Essex, painter, for the manufacture of china-ware; and in the following year they enrolled their specification, in which they state that the material used in their invention "is an earth, the produce of the Chirokee nation in America, called by the natives unaker."

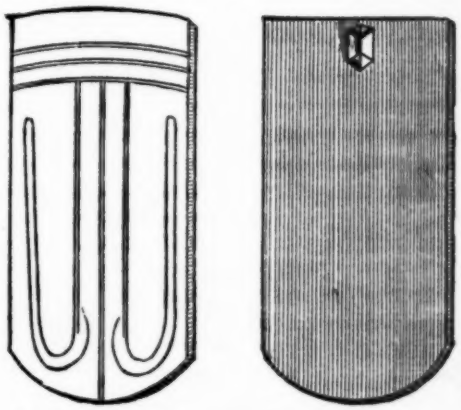


FIG. 2.—AMERICAN ROOFING TILES (eighteenth century).

In 1878 and 1879, Mr. William H. Goss, proprietor of the extensive porcelain works at London Road, Stoke-on-Trent, contributed to the English Pottery and Glass Trades' Review a series of notes on Mr. Jewitt's work. In December of the former year he wrote: "The specification of this patent is of startling interest. Who would have thought, until Mr. Jewitt unfolded this document to modern light, that the first English china that we have any knowledge of was made from American china-clay? Let our American cousins look out for, and treasure up lovingly, specimens of the earliest old Bow-ware after learning that." Then follows the specification in full as given by Mr. Jewitt, and Mr. Goss continues: "This 'unaker,' the produce of the Chirokee nation in America, is decomposed granitic rock, the earth or clay resulting from the washing being the decomposed felspar of that rock. It is curious that it should have been imported from among the Chirokees when we had mountains of it so near as Cornwall; unknown, however, to any 'whom it might concern' until Cookworthy discovered it twenty-four years later than the date of the above patent." William Cookworthy was acquainted with American clays as early as 1745, for in a letter to a friend dated fifth month, thirtieth, of that year, quoted by Mr. Jewitt, he writes: "I had lately with me the person who hath discovered the china-

earth. He had several samples of the china-ware of their making with him, which were, I think, equal to the Asiatic. 'Twas found in the back of Virginia, where he was in quest of mines; and having read Du Halde, discovered both the petunse and kaulin. 'Tis the latter earth, he says, is the essential thing towards the success of the manufacture. He is gone for a cargo of it, having bought the whole country of the Indians where it rises. They can import it for £13 per ton, and by that means afford their china as cheap as common stoneware. But they intend only to go about 30 per cent under the company."

We must not conclude from this statement that the ware which Cookworthy had seen had been made in America. It is much more probable that the pieces were some of those produced at the Bow works, within the year that had just passed, from the recently discovered American materials.

Not until 1769 was there any serious attempt made to manufacture fine porcelain on this side of the water. In Watson's Annals of Philadelphia we find the brief statement that "the desire to encourage domestic fabrics gave rise, in 1771, to the erection of a flint-glass manufactory near Lancaster, by which they hoped to save £30,000 to the province. A china factory, too, was also erected on Prime Street, near the present Navy Yard, intended to make china at a saving of £15,000." In a foot-note the author adds: "This long row of wooden houses afterwards became famous as a sailors' brothel and riot-house on a large scale. The former frail ware proved an abortive scheme." Mr. Charles Henry Hart, of Philadelphia, made the interesting discovery, a few years ago, of some old advertisements in the newspapers of that time which threw considerable light on this early American enterprise, and he has kindly placed at my disposal the results of his investigations. The first of these announcements, which appeared in the latter part of the year 1769, is as follows:

NEW CHINA-WARE. — Notwithstanding the various difficulties and disadvantages, which usually attend the introduction of any important manufacture into a new country, the Proprietors of the China Works, now erecting in Southwark, have the pleasure to acquaint the public, they have proved to a certainty, that the clays of America are productive of as good Porcelain, as any heretofore manufactured at the famous factory in Bow, near London, and imported into the colonies and plantations, which they will engage to sell upon very reasonable terms; and as they purpose going largely into this manufacture as soon as the works are completed, they request those persons who choose to favor them with commands, to be as early as possible, laying it down as a fixed principle, to take all orders in rotation, and execute the earliest first; dealers will meet with the usual encouragement, and may be assured, that no goods under Thirty Pounds' worth, will be sold to private persons out of the factory, at a lower advance than from their shops. All workmen skilled in the different branches of throwing, turning, modelling, moulding, pressing, and painting, upon application to the Proprietors, may

depend on encouragement suitable to their abilities; and such parents, as are inclined to bind their children apprentices to either of these branches, must be early in their application, as only a few of the first offering will be accepted, without a premium; none will be received under twelve years of age, or upwards of fifteen. All orders from the country, or other provinces, inclosed in letters, post paid, and directed to the CHINA PROPRIETORS in Philadelphia, will be faithfully executed, and the ware warranted equal to any, in goodness and cheapness, hitherto manufactured in, or imported from England.

Subsequently the proprietors advertised for bones, offering twenty shillings per thousand "for any quantity of horses or beeves shank-bones, whole or broken, fifteen shillings for hogs, and ten shillings for calves and sheep (a proportionable price for knuckle bones) delivered at the china factory in Southwark"; concluding with the announcement that the capital works of the factory were then completed and in full operation. The projectors of this enterprise were Gousse Bonnin, a foreigner, who had most probably learned his trade at Bow, and George Anthony Morris, of Philadelphia. In January, 1771, they applied to the Assembly for pecuniary assistance, in the form of a provincial loan, the petition being given in full by Colonel Frank M. Etting in his History of Independence Hall. In their address it is stated that the petitioners "have expended great sums in bringing from London Workmen of acknowledged Abilities, have established them here, erected spacious Buildings, Mills, Kilns, and various Requisites, and brought the Work, we flatter ourselves, into no contemptible Train of Perfection." Whether they were successful in securing the loan does not appear, but later in the same year they advertised for zaffer or zaffera, without which they could not make blue ware. In April, 1772, they advertised for apprentices to the painting and other branches, and shortly after for flint glass and "fifty wagon loads of white flint stone." The attempt, however, proved a failure in a financial point, and in the latter year the proprietors made a public appeal for charity for the workmen who had been brought to a strange country and were left without means of support. After running about two years the factory was closed, the real estate was sold, and Bonnin returned to England.

Little is known of the ware made here. The fact that zaffer was used shows that blue decorated ware was made. The Bow works at that period turned out little but blue and white china, as was the case with all of the early English factories, which employed lapis lazuli and zaffer to color beneath the glaze.

The terra-cotta works owned by Mr. A. H. Hews, at North Cambridge, Mass., were founded by his great-grandfather, Abraham Hews, at Weston, Mass., some time previous to 1765. At first only the ordinary household utensils of earthenware were

made and sold in exchange for general merchandise. After several changes in the firm name, the business descended to the present proprietor in 1865, and five years later was transferred to its present location, where it is said that more flower-pots are produced than at any other factory in the world. Here also are made the usual line of fancy garden terra-cotta and a large variety of art pottery for decorators.

Toward the latter part of the last century potteries for the manufacture of earthen and stone ware had become numerous throughout the States. During the Revolutionary period considerable china was imported from India, Holland, and England for the use of the wealthier citizens, but pewter utensils were also much in vogue. The common people used earthenware, generally red pottery, on which the first attempts at decoration were made with yellow slip. Dishes and flower-pots, with pie-crust edge and rude floral designs or dates, were common (see Fig. 17).

Before the beginning of the present century several stone-ware and earthenware potteries were started in Connecticut. In 1791 John Curtis was making a good quality of pottery in Philadelphia from clay obtained where the brewery now stands at Tenth and Filbert Streets, and his name is found in the directory as late as 1811 in the same business. In the former year Andrew Miller also made earthenware in the same town, and continued the business until 1810, when it passed into the hands of Abraham and Andrew Miller, Jr., who carried on the business jointly for about six years. In 1824 Abraham Miller displayed, at the first annual exhibition of the Franklin Institute, "red and black glazed tea-pots, coffee-pots, and other articles of the same description. Also a sample of platinated or lustre pitchers, with a specimen of porcelain and white ware, all of which exhibited a growing improvement in the manufacture, both in the quality and form of the articles." Quoting from the report of the committee: "It is but a few years since we were under the necessity of importing a considerable proportion of this description of ware for home consumption, but since our potters have attained the art of making it equal, if not superior, to the imported, and as cheap, they have entirely excluded the foreign ware from the American market." Miller continued to manufacture a fine grade of earthenware, such as plates, vases, and ornamental flower-pots, until 1858, but we can not discover that he carried the manufacture of porcelain beyond some successful experiments.

John and William Norton established a pottery in Bennington, Vt., in 1793, for the production of red ware, which was discontinued about 1800, when the manufacture of stone-ware was substituted. This ware has been made continuously ever since, the business being now carried on by Messrs. Thatcher and Nor-

ton, the latter a great-grandson of John Norton, one of the founders.

A "china" manufactory existed in Philadelphia ninety-one years ago, but very little is known regarding it. A friend has recently shown me a letter, dated August 14, 1800, written by a merchant of that city to his wife, who was then visiting in New Jersey, in which occurs the following interesting bit of news: "On account of a man being murdered at the *China Factory* on Monday evening last, a block maker by trade, a number of the same profession, with Rope makers and Carpenters, assembled and on Tuesday evening began to pull down the buildings; they continued at their work till yesterday mid-day,—it was pulled down by Ropes in spite all the Squires and Constables that could be collected—say every house, only leaving the Chimneys standing." The writer, an ancestor of the present owner of the letter, was in business at that time near Fourth and Chestnut Streets, and we are led to infer that the factory was somewhere in that neighborhood. All white ware at that time was known as *china*, and the term was evidently applied to queen's-ware—certainly not porcelain.

Paul Cushman had a stone-ware factory at Albany, N. Y., in the first decade of this century, and some examples of his ware are now in the possession of Mr. S. L. Frey, of Palatine Bridge, N. Y., one of which bears the inscription, impressed on the surface of the jar, and twice repeated around the body, "Paul Cushman Stone Ware Factory 1809 Half a Mile West of Albany Gaol."

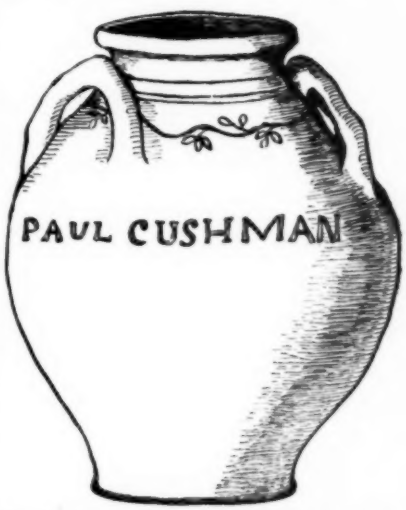


FIG. 3.—ALBANY STONE-WARE. (Collection of Mr. S. L. Frey.) Made about 1809.

In 1812 Thomas Haig, from Scotland, established a pottery in the Northern Liberties, Philadelphia, where he made red and black ware. At the Franklin Institute exhibition in 1825, articles made at this pottery were considered, "in the opinion of the judges, better than goods of the same kind brought from England." The pottery is still operated by Thomas Haig, a son of the founder, who is now in his eightieth year.

Queen's-ware was probably first made in the United States about 1800. Eight years later the Columbian pottery, on South Street, between Twelfth and Thirteenth, in Philadelphia, was

turning out white ware which was claimed to be equal in quality and workmanship to the best made in Staffordshire. Two years later Captain John Mullowney, brick-maker, was operating the Washington pottery on Market Street, west of Seventeenth; and in the files of the Aurora or General Advertiser, published in Philadelphia in 1810, this factory advertised red, yellow, and black coffee-pots, tea-pots, pitchers, etc., and called special attention to the decorating branch, artists being employed who were prepared to put any device, cipher, or pattern on china or other ware at the shortest notice.

Daniel Freytag was making in Philadelphia, in 1811, a finer quality of china-ware than had yet been produced in the United States. It was made of various colors, and was embellished with gold and silver; and in 1817 David G. Seixas manufactured an imitation of the Liverpool white crockery from native American clays with great success, continuing the business until 1822.

FIG. 4.—PORCELAIN VASE. NEW YORK, 1816.

Porcelain was made in New York city early in this century, probably by Dr. Mead. How long this factory was in operation is not known, but it is believed that a fine grade of ware was made there from American materials. A vase over a foot in height, of excellent body and exceedingly white glaze, is preserved in the Franklin Institute. This was "finished in New York in 1816," and is supposed to have been made at that factory. It is entirely devoid of gilding or coloring, and is made in two parts, held together by a screw and nut, after the French manner.

In 1823 Henry Remmey, a brother of John Remmey, the last proprietor of the New York stone-ware factory, which was closed about 1820, came to Philadelphia and embarked in the same business, which is now continued by a great-grandson, Mr. Richard C. Remmey, who now owns the largest stone-ware works in the United States. Here are manufactured fire-bricks of superior quality, and chemical stone and porcelain ware of every description, some of the vessels having a capacity of two hundred to five hundred gallons. In addition to these specialties, the factory produces a large line of household utensils, and the business has grown to such proportions that the ten large kilns are taxed to the utmost.

No considerable progress was made in the manufacture of porcelain in the United States until William Ellis Tucker, of Philadelphia, began his experiments. From 1816 to 1819 his father, Benjamin Tucker, had a china shop on the south side of Market Street, at No. 324, then between Ninth and Tenth Streets, near

FIG. 5.—TUCKER & HEMPHILL'S CHINA FACTORY. Philadelphia, 1832-'38. (From a vase owned by Mrs. Thomas Tucker.)

where the new post-office building now stands. During this period Mr. Tucker built a small decorating kiln in the rear of his store for the use of his son, who employed much of his time in painting the imported white china and firing it in the kiln. These attempts were at first only partially successful. He then commenced experimenting with different clays, which he procured in the vicinity of the city, to discover the process for manufacturing the ware itself. These experiments resulted in the production of a fair quality of opaque queen's-ware. He then directed his attention to kaolin and feldspar, and finally succeeded in discovering the proper proportions of these ingredients, in combination with bone-dust and flint, necessary for the production of an excellent grade of natural or hard porcelain. Having secured a translucent

body of great hardness, density, and toughness, capable of withstanding extreme changes of temperature, he first seriously began the manufacture of the ware for the market in the year 1825. The old water-works, at the northwest corner of Schuylkill-Second (Twenty-first) and Chestnut Streets, were obtained from the city, where the necessary glazing and enameling kilns, mills, etc., were erected. His first attempts were fraught with many difficulties. While the body and glaze of the earlier productions were good, the workmanship and decoration were inferior. The decoration consisted generally of landscapes painted roughly in sepia or brown.

In 1828 Thomas Hulme was admitted to the business, but retired in about one year. During this period great improvement was made in decoration, the best productions being painted with floral designs in natural colors. A number of pitchers made during that period are marked "Tucker & Hulme, China Manufacturers, Philadelphia, 1828," the only pieces from this factory known to have been signed.

FIG. 6.—TUCKER CREAMER. Sepia decoration.

FIG. 7.—HEMPHILL VASE. (Collection of Hon. James T. Mitchell.)

William Ellis Tucker died in August, 1832, but previous to this Judge Joseph Hemphill had put some money in the enterprise, and continued to carry on the business after his partner's death.

Messrs. Tucker & Hemphill purchased the property at the southwest corner of Schuylkill-Sixth (now Seventeenth) and Chestnut Streets, where they erected store-houses and three kilns, and greatly increased the producing capacity of the factory. In 1832 they appealed to Congress for the passage of a tariff law which would afford them protection from foreign competition.

Mr. Thomas Tucker superintended the business after the decease of his brother, which was carried on in the name of Judge Hemphill for about three years, but in 1835 the latter entered

into negotiations with a company of Eastern gentlemen, and sold the factory to them shortly after. In 1837 the factory was leased to Thomas Tucker, who continued the manufacture of fine porcelain for about one year, when it was permanently closed. Under the direction of Judge Hemphill, who had become interested in the subject while abroad, great improvements were made in the body of the ware as well as in the glazing and ornamentation. French porcelain was selected as the model after which the Tucker & Hemphill china was patterned, and skilled artists were brought from France to decorate the ware. Pitchers and vases were sometimes decorated with painted portraits of Revolutionary heroes; two of the former, with likenesses of Washington and Wayne, are still preserved. The later productions of this factory were greatly superior to anything produced in the United States before. They were characterized by smoothness of paste, beauty of coloring, and richness of gilding—indeed, it is said that the amount of gold consumed in the decoration of this ware was so great as to cause a considerable pecuniary loss to Judge Hemphill. It is a matter of regret that the limit of this article is not sufficiently elastic to permit a more extended review of this interesting factory and description of some of its many beautiful productions which have been recently brought to light.

FIG. 8.—HEMPHILL VASE (with painting of a shipwreck).

Isaac Spiegel, one of Tucker & Hemphill's workmen, started in business for himself in Kensington, Philadelphia, about 1837. He made Rockingham black and red ware of excellent quality, including mantel ornaments, such as figures of dogs and lions. Some of the machinery was moved to his pottery from the Hemphill factory on its closing, and he secured many of the molds which had been used for making ornamental porcelain pieces. In 1855 Mr. Spiegel retired from active business, and was succeeded by his son Isaac, who carried on the works until 1879. In 1880, John Spiegel, a brother of the latter, resumed the business, and is at

the present time engaged in burning magnesia for the drug trade.

About the time that Tucker first placed his new ware on the market a factory for the production of a somewhat similar commodity was erected at Jersey City, presumably by Frenchmen. Later, under the title of the American Pottery Company, cream-colored, white, Parian, and porcelain wares were made here. In 1842 an exhibit of embossed tea-ware, jugs, and spittoons was made by this company at the Franklin Institute, the specimens of Parian with blue ground and raised ornamentation in white being especially praiseworthy. After several changes in proprietorship the business passed into the hands of Messrs. Rouse & Turner in 1870, and the name of the factory was altered to the Jersey City Pottery. Mr. John Owen Rouse came from the Royal Derby Works about forty years ago. Mr. Turner died in 1884, leaving the former sole proprietor. The plant at present consists of four kilns, one of which has an interior diameter of nineteen and a half feet, and numerous large buildings for manufacturing and storage purposes. Here are now made large quantities of white granite ware in table and toilet services and decorative designs, a specialty of the factory being porous cups for telegraphic uses, of which fully five thousand are produced every week.

After the year 1840 the number of potteries in the United States multiplied rapidly. About that time Samuel Sturgis was making, in Lancaster County, Pa., in addition to earthen and stone ware, clay tobacco-pipe bowls, which he molded after the French designs in the form of human heads. These were glazed in yellow, green, and brown, and supplied largely to the tobacconists of eastern Pennsylvania. In 1843 there were one hundred and eighty-two potteries in that State alone, few of them, however, of any importance, whose aggregate productions amounted to $158,000. In 1890 there were only about eighty potteries in the same State, a falling off of more than half. This diminution in number does not by any means indicate a decadence of this industry, because the establishments of half a century ago were mostly scattered through the rural districts and were insignificant affairs, producing only the coarser and cheaper grades of crockery. Such potteries have almost entirely disappeared, while those of to-day manufacture, for the most part, the finer qualities of earthen, white granite, and porcelain wares. At the present time there are over five hundred potteries in the United States, not including architectural terra-cotta and tile works, of which some twenty-five are in Trenton, N. J., and about the same number in East Liverpool, Ohio.

An exhibit of Rockingham was made at the Franklin Institute in 1846 by Bennett & Brother, of Pittsburg, which was

FIG. 9.—ROCKINGHAM MONUMENT. Made at Bennington, Vt., 1851.

pronounced by the judges superior to the English ware. A "tortoise-shell" pitcher, eight-sided, with human head molded in relief under the mouth, which is still in the cabinet of the Institute, was awarded a silver medal.

Messrs. Alanson Potter Lyman and Christopher Weber Fenton embarked in the manufacture of yellow and Rockingham ware in Bennington, Vt., about 1847. Three years later they commenced making white ware. Their workshop was known as the United States Pottery. In 1851, or the year following, Mr. Fenton had a large monumental piece of Rockingham made, ten feet in height, in which was placed a life-sized Parian bust of himself surrounded by eight glazed columns, the work being surmounted by figures of a woman and child in Parian. This was modeled by Daniel Greatbach, formerly connected with the Jersey City Pottery. The base of the monument is made of several varieties of clay mixed together, having the appearance of unpolished marble. It stands at present on the porch of Mr. Fenton's former residence in Bennington, having been first placed on exhibition at the New York Crystal Palace in 1853, with other productions of this factory, including a group of "patent flint enameled ware," which was probably analogous to the so-called majolica of the present day. Common china, white granite, and Parian were made here extensively. A limited amount of soft porcelain was produced also, but chiefly in small ornamental figures and statuettes. These, like the Parian pieces, were often copied from old English works. A graceful pitcher of the latter ware, in the collection of the writer, is molded with white figures in relief on a dark-blue "pitted" ground, and is almost an exact, though enlarged, reproduction of a sirup-jug from the Dale Hall Works, England. The jasper-ware of Josiah Wedgwood was also imitated in Parian. The art of the American potter had not yet reached that point where competition and public demand stimulated originality in body, design, or decoration. Fig. 10 shows a group of pieces made at the Bennington factory between 1850 and 1855. In the center may be seen a large Rockingham figure, beneath which are two small mantel ornaments of artificial porcelain. The central pitcher above the dog and the two small pitchers to the right are white granite, decorated in gold. The three remaining pitchers and the small vase are Parian, with ornamentation in relief.

The United States Pottery was closed in 1857, and two years later Mr. Fenton, with Mr. Decius W. Clark, his former superintendent, went to Peoria, Ill., and there established a manufactory of white and granite wares. After a period of three years this experiment proved a financial failure, and the factory passed into other hands. At present it is being successfully operated by the

Peoria Pottery Company, which makes a fine grade of similar goods.

Messrs. Haughwout, Dailey & Co. had a decorating establishment in New York city in 1853, and employed a hundred hands in painting French china for the American market. Mr. James Carr, who came to this country in 1844, worked for the American Pottery Company of Jersey City until 1852, when he went to South Amboy, and there established a pottery for the manufacture of

FIG. 10.—WARE MADE BY LYMAN & FENTON.

yellow and Rockingham wares. In October, 1855, he started a pottery in New York, under the firm name of Morrison & Carr, where table-services in opaque china, white granite, and majolica were made. He directed his efforts toward the attainment of higher standards, and his experiments resulted in the production of some artistic pieces of porcelain and faience, excellent both in design and execution; but as there was little demand for this class of goods at that time, these attempts were discontinued. In 1888, owing to the close competition of out-of-town manufacturers, the New York pottery was closed and the factory torn down. Mr. Carr has recently built, on the premises in West Thirteenth Street, several large stores, the rentals from which, he claims, yield him better returns than potting.

The Philadelphia City Pottery of Mr. J. E. Jeffords, who came from the New York establishment of Messrs. Morrison & Carr about 1860, includes two distinct factories, one of which turns out a high grade of Rockingham, yellow, and white-lined blue ware, while the adjoining workshop produces an excellent variety of white and decorated earthenware for toilet and table use. In Rockingham some of the old English designs are reproduced, such as the "Toby" ale-jug and the cow creamer. A few years ago a more elaborate ornamentation was attempted in the paint-

ing of bird and floral subjects above the glaze, but this was soon discontinued owing to the expense. Printing from copper plates is extensively practiced here at the present time, and competent artists are employed to apply the gold in pleasing devices to the rich dark glazes which characterize the better grades of ware produced. Mr. Jeffords has fully equipped his factories with the most approved modern appliances, and is one of the most progressive and successful of our modern potters.

Mr. Alexander William Robertson started a small pottery in Chelsea, Mass., in the year 1866, for the manufacture of brown ware such as was made in Great Britain, and of lava-ware similar to that of Germany. Two years afterward, Mr. Hugh Cornwall Robertson, a younger brother, was admitted to partnership in the business, the firm name being A. W. & H. C. Robertson, when the production of brown ware was discontinued and the manufacture of plain and fancy flower-pots was substituted. In the following year porous cones or filters of a high grade were made for chemical purposes. In 1872 James Robertson, a practical potter of wide and varied experience in Scotland, England, New Jersey, and New York, and recently from the East Boston pottery, joined his sons, the firm name being changed to James Robertson & Sons, when work of a more pretentious character was undertaken. A red bisque ware, in imitation of the antique Grecian terra-cottas and Pompeiian bronzes, was first produced in 1875. The factory adopted the name of the Chelsea Keramic Art Works. The red ware was characterized by a remarkably fine texture and smooth finish, the clay being peculiarly adapted to the faithful reproduction of the graceful classic forms, the fine polished grain offering an excellent surface for the most minute carving, showing the engraved lines as perfectly as on wood. In 1876 a pleasing effect was obtained by polishing the red ware with boiled linseed oil. On a few spherical vases thus treated, Mr. F. X. Dengler, the talented young sculptor who afterward died at the age of twenty-five, modeled from life, in high relief, choosing child and bird forms. The firm also received the benefit of advice from a number of capable artists, including, John G. Low, G. W. Fenitz, and others. For lack of public support this branch of the art was abandoned. The next venture was the Chelsea faience, introduced in 1877, which is characterized by a beautiful soft glaze. This ware soon attracted the attention of connoisseurs, and carried the firm to the front rank of American potters. The decoration consists of floral designs, either made separately by hand and sprigged on, or carved in relief from clay laid directly on the surface while moist. Some beautiful effects were produced by hammering the surface of the faience before burning, and afterward carving sprays of flowers in relief in clay applied to the

surface. This modeling was executed by Miss Josephine Day, a sister-in-law and pupil of Mr. H. C. Robertson, and by Mr. Robertson himself. Being done by hand from original designs, no duplicates were produced. On some of the hammered vases the designs were cut into the surface and filled in with white clay, forming a mosaic, the bases of the vessels being colored buff, which offered a pleasing contrast through a semi-transparent

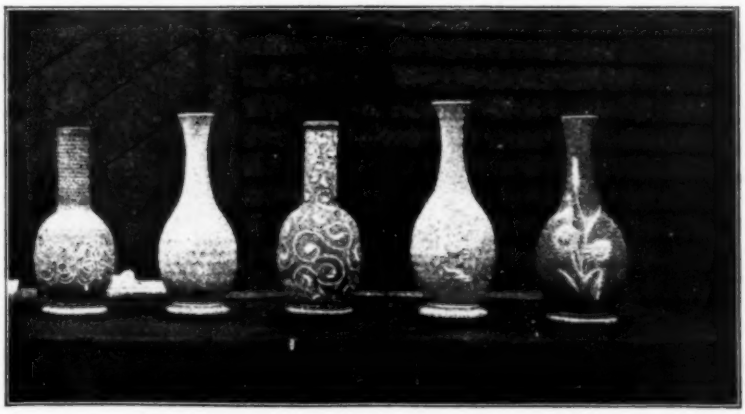


FIG. 11.—INLAID, HAMMERED AND EMBOSSED POTTERY. (Chelsea Keramic Art Works.)

glaze. About the same time a variety of faience known as the Bourg-la-Reine of Chelsea was produced, after the discovery of the process of painting on the surface of the vessel with colored clays and covering with a transparent glaze, on the principle of the Limoges faience.

Mr. James Robertson died in 1880, after a long and useful life, at the ripe age of seventy years. The firm continued under the same name, and in 1884 A. W. Robertson retired from the business. In that year the remaining partner, Mr. Hugh C. Robertson, discovered a stone-ware somewhat resembling Parian in appearance, possessing a hard, vitrified body, which he worked into a variety of artistic forms.

From this time Mr. Robertson directed his efforts toward solving the secret of the famous Chinese *Sang de bœuf*, and after four years of sacrifice and patient investigation his labors were crowned with success. This discovery is the exact treatment necessary to produce the true ox-blood red, which with the Chinese was the result of accident rather than an established art. The body is the true stone, perfectly water-proof, and capable of resisting as high a degree of heat as any known ware. The forms of the vases are simple, with curving outlines, and entirely devoid of ornamentation which would tend to impair the beauty of color, which is that of fresh arterial blood, possessing a golden

lustre, which in the light glistens with all the gorgeous hues of a sunset sky. In experimenting to obtain the blood-red of the *Sang de bœuf*, varieties were produced of a deep sea-green, "peach-blow," apple-green, mustard-yellow, greenish blue, maroon, and rich purple. Specimens of this ware have been secured by a number of prominent collectors throughout the United States, but the demand for works of this character being limited, the remaining examples which were produced still rest on the dusty shelves in the Chelsea workshop. The history of the discovery of this process is a repetition of the old story of genius.

FIG. 12.—PLAQUE REPRESENTING SPRING. (Designed by H. C. Robertson, 1879.)

After twenty-four years of devotion to art, Mr. Robertson finds himself unable to prosecute the work further, and for over two years the fires have not been lighted in his kilns. It is difficult to explain the apparent indifference of Americans to works of artistic merit which emanate from their countrymen.*

* Since writing the above, word comes to us that a company has been incorporated under the name Chelsea Pottery U. S., and date July 17, 1891, of which Mr. Hugh C. Robertson will be the manager.

Thus far we have attempted to review, in the briefest manner, some of the earlier potteries in the United States. The space at command has only permitted the bare statement of facts relating to the condition of the ceramic industry down to the period just preceding the Centennial Exposition of 1876. It has not been possible to refer to many establishments whose record would be necessary to a full history of the development of this art. Let us now see what progress has been made in the methods employed in this country down to the present time.

The potter's wheel used well into the present century was a clumsy and primitive affair. It consisted of a perpendicular beam, generally about two feet in height, surmounted by a circular disk a foot or so in diameter. At the lower extremity of the beam or axis was a horizontal wooden wheel, four feet across, possessing four inclined iron spokes which extended from the beam to the rim of the wheel, which the workman pushed around with his feet. He sat on a framework behind the wheel, while in front were piled the lumps of clay to be manipulated.

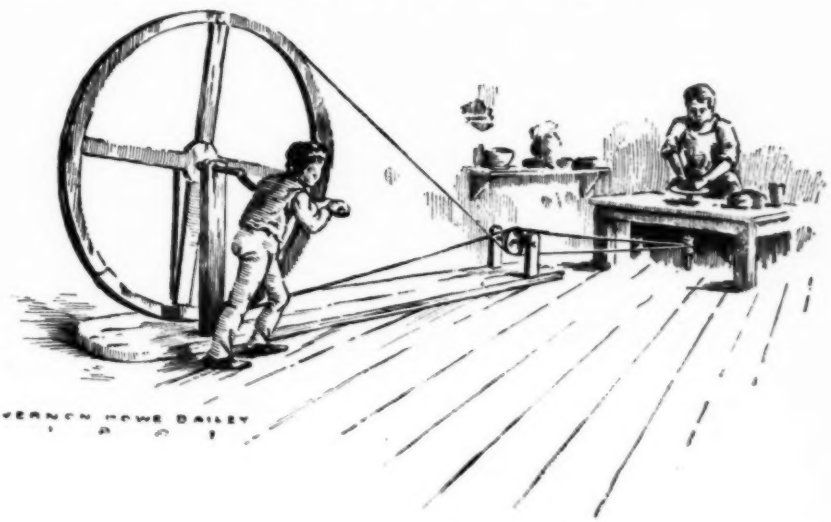


FIG. 13.—OLD-FASHIONED "THROWING WHEEL."

A great advance was made in potters' machinery a few years later, or in the first quarter of the present century, when the "throwing wheel" was introduced into the more prominent factories. This was composed of a plate or disk which was revolved by means of a belt which passed around two spindles and extended to a large vertical wheel operated by a crank in the hands of a second person. This upright wheel usually measured four, five, or more feet in diameter, depending on the rate of velocity desired; the larger the wheel, the greater the speed to be attained.

The revolving plate at which the potter sat was often ten or more feet from the crank-wheel, and the apparatus was therefore cumbersome, besides requiring the services of an extra hand. This contrivance was a great improvement over the old method of turning, as it secured uniformity of motion and enabled the operator to devote his entire attention to his work. This style of wheel, in time, was superseded by the more simple form which is worked by a treadle with the left foot of the operator, and is still used in many of the smaller potteries. The subjoined engraving

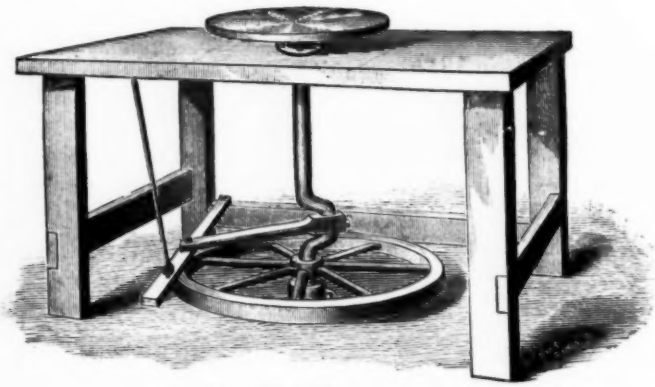


FIG. 14.—"KICK WHEEL (now used).

represents one of these "kick" wheels, as made at the present time by Messrs. Taplin, Rice & Co., of Akron, Ohio. This firm also manufactures a power-wheel such as is now operated in the larger factories, which is so constructed that the velocity can be regulated by a foot-lever.

The old methods of grinding and mixing clays by hand have given place to improved mechanical processes. In olden times it was customary for one or two men to manipulate the clay, which was placed in a square tank sunk in the floor, with a wooden shovel or paddle. Now this work is performed much more effectively and rapidly by special machinery known as "blungers," "pug" and "grog" mills, etc. Some of the improved grinding mills have a capacity of twenty-five tons or more per day, and the agitating and mixing machines perform the work of many men.

I have in my possession a drawing of the old-fashioned slip kiln used by Messrs. Tucker & Hemphill in 1832. This consisted of a long horizontal brick fire-box, at one end of which were built three partitions or pans, one after the other. In these the slip was poured, and flues passing around the sides furnished the heat necessary to dry the clay to the proper consistency. This drying process was necessarily a slow one. The contents of the pan nearest the fire-box would be ready for removal first, and

the others in succession. A recent invention has simplified this process very materially. This device is a clay press consisting of a series of sacks in which the slip is placed. The moisture is forced through the bags by strong pressure, and the clay is ready for use. Mr. A. J. Boyce, of East Liverpool, Ohio, has recently perfected an improved hydrostatic press, which is being introduced into many of the more progressive factories throughout the country. The illustration will convey a clear idea of the clay

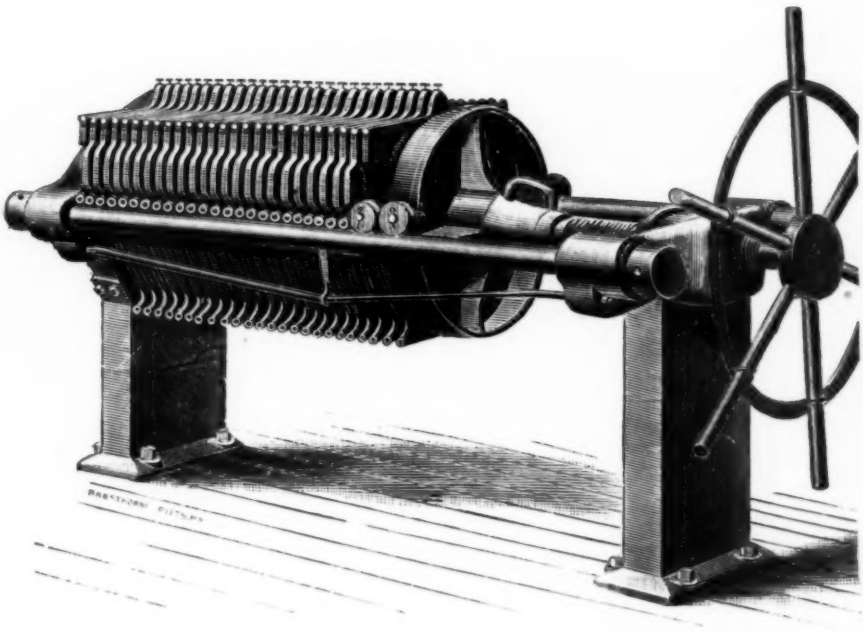


FIG. 15.—THE BOYCE CLAY PRESS, WITH TWENTY-FOUR CHAMBERS.

press used in reducing the slip to a workable mass. In each chamber is placed a sack made of ten-ounce Woodberry duck, which, if of the proper quality, will last some time. The moisture is pressed through the fabric, and the clay, on removal, is ready for manipulation.

"Jiggers" and "jollies" now greatly facilitate the manufacture of circular and swelled vessels, such as jars, jugs, crocks, cuspidors, and umbrella jars. A "jigger" is a machine which carries a revolving mold, in which the clay is shaped by a former, which is brought down into the mold and held in place by means of a lever. We give here an illustration of one of the jiggers made by Mr. Peter Wilkes, of Trenton, N. J. *A* is the jigger-head or receptacle in which the mold is placed, which is screwed fast to the revolving spindle. *B* is a stationary iron column on which the frame or sleeve *C* slides up or down. *D* is an iron fork

which prevents the frame *C* from turning. *E* is the former or profile which shapes the interior of the vessel. The lever or pull-down, above the horizontal bar *F*, gives a transverse motion, and forces the former toward the side of the mold. 1 and 2 are adjustable collars which are fastened by screws; 1 regulates the distance to which the collar or frame *C* must be lowered to give the proper thickness to the bottom of the vessel, while 2 acts as a stop to prevent the frame from being thrown up too high.

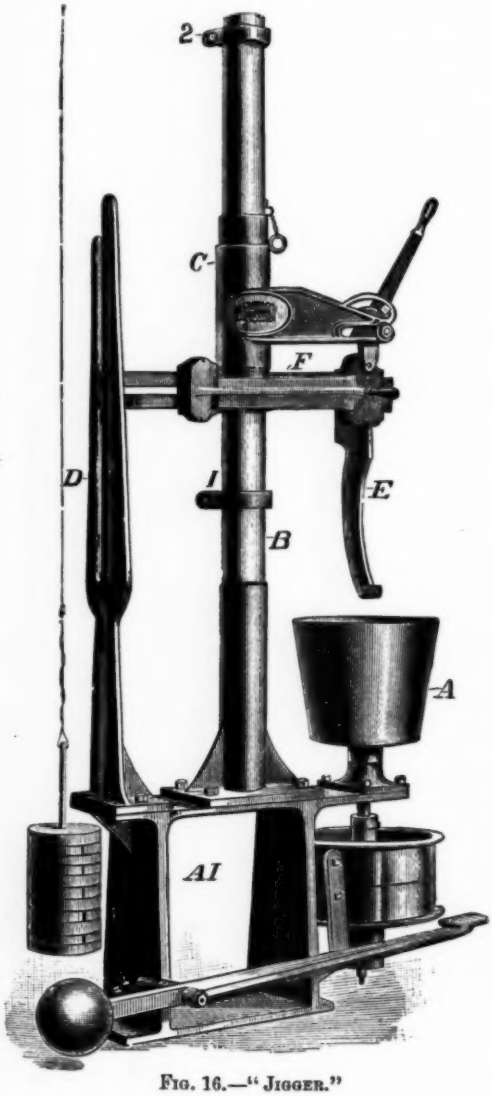


FIG. 16.—"JIGGER."

A "jolly" is a somewhat similar contrivance, consisting of a table on which is a revolving mold with a single or double pull-down.

The construction of pottery kilns has changed but little in the past fifty years. The glaze kiln of the Tucker & Hemphill factory was made on the French plan. It possessed six fire-boxes and the same number of flues, eight inches in width, which passed through solid walls and met in the center. Besides the central space there were two circular passages, one extending around the circumference of the kiln and another midway between this and the center. Modern kilns are generally made about fifteen to sixteen and a half feet diameter inside, and measure about the same in height to the crown, with usually ten fire-boxes. In some of the Western kilns slight modifications have been made in the latter for the employment of natural gas, which is used instead of coal.

Until quite recently each establishment made its own saggers or fire-clay boxes in which the ware is burned, but now they are made in large numbers by machinery and supplied to the trade by the Trenton Terra-Cotta Company at a very low price. In the manufacture of earthenware formerly, "cockspurs" were used to separate the pieces when placed in the kiln. These were small four-pointed objects of clay formed somewhat like the old-fashioned caltrop, three of the arms resting on the lower vessel while the upper supported another above. Three spurs being used, it is evident that the upper surface of the lower piece would show nine marks after coming out of the kiln, where the points tore away the glaze, as in old Delft plates. The bottom of the upper vessel would show three. "Cockspurs" and "cones" were superseded by "pins" and by "triangles" and "stilts," having three horizontal arms, equidistant, with double points projecting upward and downward. These were for some time made by hand at the factories where they were to be used, but recently they have been made in assorted sizes by machinery, and sold to potters more cheaply than they could be made by hand.

Labor-saving machines have greatly simplified the work of the potter. Steam power has to a great extent taken the place of hand and foot power in running wheels, lathes, "jiggers," and "jollies." Steam grinding-mills, "blungers," sifters, and clay-presses now grind, sift, mix, dry, and prepare the clay for the workman. There are many other problems to be solved, however, in order to still further cheapen the production of utilitarian articles. The committee appointed by the United States Potters' Association to investigate the subject of potters' machinery, in their report presented at the convention held in 1890, used the following language: "We think we can see in the distance a cloud no bigger than a man's hand, which we trust will speedily increase to such proportions that the industry will feel the outpouring of benefits such as have not entered into the imagination of the potter's mind. We require only to get the

FIG. 17.—SLIP-DECORATED PIE DISH. ALLENTOWN, PA., 1826.

American mechanical mind turned in the direction of our need, and we will not fear for the future of our business.

"We would urge upon the manufacturing potters that more thought be given to this subject, and that they come in closer touch with the best machinists of our several centers. Let the practical machinist know our need. Much can be done; much must be done if we expect to hold our own. And what is our own? The American market for American manufacturers."

NOTE.—Several of the illustrations which appear in this paper are from pen-and-ink drawings made from the original porcelains by Mr. Vernon Howe Bailey, a student at the Pennsylvania School of Industrial Art, Philadelphia.

[*To be continued.*]

PROGRESS AND PERFECTIBILITY IN THE LOWER ANIMALS.

BY PROF. E. P. EVANS.

WHAT we call institutions are only organized and hereditary instincts, and are common to man and the lower animals. The original social character of animals, which forms the basis of their institutions, is also the quality that renders them capable of domestication. Man simply takes advantage of this quality, and turns it to his own account by bringing the animal into his own domestic circle and service and making it a member of his household.

In birds, for example, the conjugal instinct is remarkably strong, or, as we would say in speaking of human relations, the institution of marriage, either in its monogamous or polygamous form, is firmly established and highly developed, and forms the foundation of a well-ordered domestic and social life.

The paternal fox trains his young with as much care and conscientiousness as any human father; the beaver constructs his habitation with the foresight of a military engineer and the skill of an experienced architect; the bee lives in well-regulated communities, forms states, and founds colonies; and the ant not only cultivates the soil, plants crops, gathers in the fruits of his labor and stores them for future use, and keeps other insects as domestic cattle, but shares also the vicious propensities and domineering disposition of man, waging war on creatures of his own species and holding his prisoners as slaves.

These habits or customs have the same origin and character in the lower animals as in man, being in both cases products of evolution and undergoing modifications from generation to generation. Animal, not less than human, societies are governed by

their laws and traditions, and preserve a sort of historical continuity by which past and present are bound together in a certain orderly sequence. Bee-hives which suffer from over-population rear a queen and send forth with her a swarm of emigrants to colonize, and the relations of the mother-hive to her colonies are known to be much closer and more cordial than those which she sustains to apian communities with which she has no genetic connection. Here the ties of kinship are as strong and clearly recognized as they are between consanguineous tribes of men.

Again, the statement that animal habits are fixed, and human customs variable and improvable, is true only to a very limited extent. Closer observation has shown the latter to be more stable and the former more mutable than is generally imagined, especially if we compare the highest orders of animals with the lowest human tribes. In primitive society and among savage races customs remain the same for countless generations, and seem to be quite as persistent and incapable of change as animal instincts.

Not only do animals, often in the course of a comparatively short period, undergo marvelous transformations both of mind and body, through the force of natural selection or by careful interbreeding, but they are also led by circumstances and through forethought to make conscious and intentional changes in their manner of life.

It is curious to note the variety of characteristics distinguishing members of the same family or genus. Thus, the European cuckoo lays her eggs in the nests of other birds, and leads the life of a shiftless parasite and shameless polyandrous vagabond. The American cuckoo, on the contrary, has not yet learned to shirk her maternal duties and domestic responsibilities, but, like an honest and thrifty housewife and conscientious mother, hatches her own eggs and rears her own young. The South African and Australasian representatives of the *cuculinæ* follow, in this respect, the habits of the European bird. There is also a species of *molothrus*, which sometimes begins but seldom finishes a nest, like the hypothetical man in the parable, who would fain build without first sitting down to count the cost. She is seized occasionally with a spasm of virtuous endeavor in this direction, but soon yields to the greater comfort and convenience of imposing upon others the burden of brooding and nurturing her offspring. Evidently she turns the matter over in her mind, and, like Rousseau, reasons herself into the belief that it is better not to assume any family cares, but to cast her children as foundlings upon the bosom of public charity. "There are the goldfinches, thrushes, fly-catchers, cardinal grossbeaks, and other fussy motherly fowl," she seems to say, "willing enough to undertake the charge; why not gratify their low philoprogenitive passion, and thus enable me to devote

myself to more congenial pursuits!" Still another kind of *molothrus* leads the life of a squatter, never building a nest of her own, but brooding in the abandoned nest of some other bird.

Many birds have, within the memory of man, made considerable advances in architectural skill, and adopted new and improved methods of constructing their nests. This progress has been observed especially in California since the settlement of that country, and in all cases the young profit from the knowledge acquired by their parents, and the improvement becomes a permanent possession of the race. In places where they are particularly exposed to the attacks of pugnacious sparrows, they have been known to close the opening in front of their nests and make the entrance on the back near the wall. In some instances this purely precautionary and defensive change of structure, after its efficiency had been tested in a single nest, has been adopted by the swallows of an entire district. Orioles, according to the observations of Dr. Abbott, finding that the bough from which they have suspended their nest is too slight to sustain the weight of the full brood, attach it by a long string to the branch above, fastening it securely "by a number of turns and a knot." It would be difficult to say in what respect the mental process leading to the adoption of such a mechanical contrivance differs from that which causes an architect to buttress a weak wall.

The Baltimore oriole also adapts the texture and structure of its nest to the exigencies of climate. In the Southern States it selects a site on the north side of a tree, and builds of Spanish moss loosely put together and without lining, so as to permit a free circulation of air. Farther north it seeks a sunny exposure, builds more compactly, and uses some soft material for lining. The impulse to build is instinctive, but conscious intelligence is exercised in modifying the methods of building to suit circumstances.

The same bird now uses yarn and worsted instead of vegetable fiber for its nest, but it always selects for this purpose the least conspicuous colors, such as gray and drab; and yet the bird's gorgeous plumage is proof, according to the theory of sexual attraction, that bright colors are pleasing to it. Here we have an example of æsthetic pleasure being subordinated to considerations of safety; the prudent oriole, notwithstanding its fondness for resplendent hues, choosing those colors which render its nest less visible and more difficult to discover, and rejecting those which, in other respects, are more gratifying to its fancy.

The tailor-bird of East India used to stitch the leaves of its nest together with fine grass, horse-hair, and threads, which it twisted out of wool; since the introduction of British manufactures it uses sewing-thread and the filaments of textile fabrics,

except in remote regions, where the ingenious bird still works on in the primitive way. So, too, in America, birds in constructing their nests everywhere turn to their account the products of human industry and keep abreast with the progress of the age. The materials employed correspond to the contemporary state of civilization, and mark the periods of industrial development through which the human race has passed. The wagtails, in a watch-making district of Switzerland, have learned to build their nests of fine steel shavings; a nest of this kind, if preserved, would indicate to the inhabitants of that country a thousand years hence the kind of industry that was carried on by their ancestors. Sparrows, which usually build in chinks of walls or under roofs, if forced to build their nests in trees or other unsheltered places, cover them with a sort of hood to keep out the rain. Buffon, who records this fact, adds: *L'instinct se manifest donc ici par un sentiment presque raisonné et qui suppose au moins la comparaison de deux petites idées.* In the presence of such clear manifestations of thought and reflection, it seems absurd to speak of a "sentiment almost reasoned," or to indulge in condescending baby-talk about "two little ideas."

Apiarists now provide their hives with artificial comb for the storage of honey, and the bees seem glad to be relieved of the labor of making cells as their predecessors had done. Instead of gathering propolis from the buds of plants, the workers stop their hives with the mixture of resin and turpentine with which the arboriculturist salves wounded trees, and readily substitute oatmeal for pollen if they can get it. These facts, and many others which might be adduced, suffice to prove that animals avail themselves of new discoveries and easier methods in order to increase the comforts and conveniences of life.

Even instincts, which seem firmly rooted and are regarded as characteristic of the class, are by no means so persistent as is commonly supposed. The individual inherits, but soon loses them if they are not brought into early exercise. A duck or gosling, if reared in the house until it is two or three months old, has no greater liking for the water than a chicken, and if thrown into a pond will scramble out, showing signs of great fear of the element to which its web-feet are particularly adapted. An artificially hatched chicken does not attach itself to a hen more than to any other animal, but follows its first associate, a child, a cat, or a dog.

Buffon denies that animals are susceptible of what he calls "the perfectibility of the species." "They are to-day," he says, "what they always have been, and always will be, and nothing more; because, as their education is purely individual, they can only transmit to their young what they themselves have received

from their parents. Man, on the other hand, inherits the culture of ages and gathers and conserves the wisdom of successive generations, and may thus profit by every advance of the race, and, in turn, aid in perfecting it more and more."

This assertion has been repeated by scientists of the old school as though it were an axiom of natural history, instead of an arrogant anthropocentric assumption refuted by scores of well-authenticated facts. The whole process of domestication, which is to the lower animals what civilization is to man, and the possibility of producing and propagating desirable qualities in the race, run counter to Buffon's theory. The value of a horse's pedigree depends upon the transmissibility of distinctive characteristics which were originally peculiar to some individual horse, idiosyncrasies which commended themselves to man as worthy of preservation, or such as in the natural struggle for existence would assert and propagate themselves.

If the descendants of blood-horses do not inherit the individual training of their sires, neither are the children of scholars or musicians born with a knowledge of books or the ability to play on musical instruments. What is inherited in both cases is some particular disposition or endowment, a superior aptitude for the things in which their progenitors excelled. Indeed, this heritage is handed down in horses with surer and steadier increase, or, at least, with smaller loss and depreciation than in human beings, since they are mated with sole reference to this result; and there is no room left for the play of personal fancy and caprice, or for social, sentimental, or pecuniary considerations, which exert a baneful influence upon marriage from a physiological point of view, and contribute to the deterioration of the race. This is strikingly perceptible in some portions of Europe, where the struggle for existence, and especially for high social position, is exceedingly intense, and a large dower suffices to cover up all mental and physical deficiencies in the bride.

The scientific swine-breeder keeps genealogical tables of his pigs, and is as jealous of any taint in a pure porcine strain as any prince of the blood is of plebeian contamination. In both cases the vitiation bars succession, the one condition of which is purity of lineage. It is by the selection not only of the finest stock, but also of the choicest individuals for breeding, that animals are "progressively improved" both bodily and intellectually. This is, perhaps, most clearly observable in hunting-dogs and race-horses, which have undergone quite remarkable modifications within the present century owing to the extraordinary pains taken to develop and perfect their peculiar characteristics. In some instances unusual births or freaks of nature are preserved, and by persistently propagating themselves form the starting-

point of new species. A striking example of this perpetuation of individual peculiarities is the short-legged and long-backed Ancon sheep, a comparatively recent product of Nature rendered permanent by the care of man. A pointer, greyhound, or collie inherits and transmits to its offspring not only race attributes, but also acquired aptitudes in the same manner and to the same degree as a human being does who is distinguished for some special faculty. There are prodigies of dogs which do not beget prodigies of puppies, just as there are men of genius whose children are by no means eminent for their intellectual endowments.

If the conceptual world of the lower animals is limited and fragmentary, so is that of savages and of ignorant and uncultivated men, who live for the most part in the present and the immediate past, and have a relatively narrow range of thoughts and experiences. Long-lived animals, such as parrots, ravens, and elephants, have an advantage over short-lived animals in the development of intelligence. Civilized man, however, not only lives his own individual life, and profits, like other animals, from the wisdom of his parents and the influences of his environment, but also, by means of written records, lives the life of the race, of which he enjoys the selectest fruits garnered in history.

It must also be borne in mind that dogs are and always have been bred for special purposes, such as pointing, retrieving, running, watching, and biting, but not for general intelligence. Mr. Galton, who calls attention to this fact, suggests that it would be interesting as a psychological experiment to mate the cleverest dogs generation after generation, breeding and educating them solely for intellectual power and disregarding every other consideration.

In order to carry out this plan to perfection and to realize all the possibilities involved in such a comprehensive scheme, it would be necessary to devise some system of signs by which dogs would be able to communicate their ideas more fully and more clearly than they can do at present, both to each other and to man. That the invention of such a language is not impossible is evident from what has been already achieved in the training of dogs for exhibition, as well as from the extent to which they have learned to understand human speech by mere association with man. Prof. A. Graham Bell believes that they may be taught to pronounce words, and is now making scientific experiments in this direction. The same opinion was expressed two centuries ago by no less an authority than Leibnitz, who adduces some startling facts in support of it. The value of such a language as a means of enlarging the animal's sphere of thought and power of conception, and of giving a higher development to its intellectual faculties, is incalculable.

Every dog trained as a hunter or herder is a specialist, and is prized for one fine capacity attained in some degree at the expense of mental proportion and symmetry; in miscellaneous matters outside of his province he may be easily surpassed by any underbred and mongrel but many-sided village cur. Modern scholarship shows a like tendency to psychical alogotrophy or one-sided intellectual growth. As science deepens its researches, each department of investigation becomes more distinct, and the toiler in the mines of knowledge is forced to confine his labors to a single lode if he would exhaust the treasures it contains. He sees clearly so far as his lantern casts its rays; but all outside of this small luminous circle is dense darkness.

If a race of superior beings had taken charge of man's education for thousands of years and conducted it on the same principle as that which has guided us in domesticating and utilizing the lower animals, what maimed specimens of humanity would have been the result! Slavery has always tended to produce this effect; but the slave, however degraded his condition, speaks the same language as his master, thereby profiting from his intercourse with those who are placed over him, and sharing in the general progress of society more fully than any dumb animal could do. So, too, the position which Christian intolerance assigned to the Jews for many centuries, closing to them all branches of industry except usury, developed in them a peculiar talent for finance, together with many hard and offensive traits of character naturally growing out of money brokerage, and finally becoming almost innate. In the middle ages they were made to serve as sponges to suck up the people's substance in order that it might be squeezed out of them at the convenience of the rulers. King John II, surnamed the Good, issued in 1360 a decree permitting the Jews in his realm to take, as compensation for loaning money, "quatre deniers par livre par semaine," equivalent to ninety per cent per annum, not from any feeling of favoritism for the Israelites, but, as he expressly stated, because "the greater the privileges enjoyed by the Jews, the better they will be able to pay the taxes levied on them by the king." This "good" monarch was wont to confiscate periodically a large portion of the pillage thus obtained in order to replenish his exhausted exchequer, and was actually praised by his subjects for punishing Jewish rapacity. It was a system of indirect taxation worthy of modern tariff legislators.

In the early part of the thirteenth century, Frederic II, the Hohenstaufen, ordained that the Jews should be permitted to dwell in Nuremberg and to lend money on interest, stating that, "inasmuch as this sinful business is essential to trade and to the commercial prosperity of the city, it would be a lesser evil to let the

Jews carry it on than that Christians should imperil the salvation of their souls by such practices, since the former, owing to their notorious obduracy, will doubtless persist in their religious perversity and be damned anyhow." If the Jews now "take a breed of barren metal" as naturally as a pointer takes to pointing or a hound to the trail of a fox, this tendency is due in part at least to circumstances which they did not create and could not control. The chief accusation brought against them by anti-Semitic agitators is that they are unwilling to follow industrial or agricultural pursuits, in utter forgetfulness of the fact that until a comparatively recent date they were forbidden by Christian legislation either to engage in mechanical employments or to own land.

The influence of domestication on the mental development of animals depends upon the purposes which the domesticator has in view. If he regards them merely as forms of food, and his sole aim is to increase the amount of their adipose tissue and edible substance and thus get the maximum of meat out of them, then domestication tends to stupefy them. The intellectual training of the pig would naturally diminish the quantity of lard it would produce. So far as man is concerned, this latter function is the chief end of the porker's existence, and it must not be *tried* and found wanting in this respect, whatever may be its mental deficiencies. It must be fat-bodied whether it be fat-witted or not, and the natural qualities which do not contribute to its gross weight and enhance its ultimate value as victuals are systematically discouraged and depressed.

In view of the treatment that the pig has received for centuries at the hands of man, it is remarkable that the animal has retained so much of its original cunning and love of cleanliness as it now possesses. That a creature so fond of bathing in pure running water should be condemned to a filthy sty is an act of unconscious cruelty discreditable to human discernment. If the sow that has been washed returns to her wallowing in the mire, it is as a last resort in hot weather; she would much prefer a clear pond or limpid stream if she could get access to it.

Being fed and protected by its owner in its domestic state, the hog no longer needs to exercise the faculties which were essential to the self-preservation of its wild progenitors. The stimulus arising from the struggle for existence ceases, and, as it is reared solely to be eaten, its association with man does not call forth any new powers. In China and Polynesia, where the dog is esteemed chiefly as food, it is a sluggish and stupid beast. On the other hand, the pig can be trained to hunt, and not only acquires great fondness for the sport, but also shows extraordinary sagacity in the pursuit of game. It has an uncommonly keen scent, and can be taught to point better than the pointer.

Curiously enough, when the pig is used for hunting purposes, the dogs, usually so eager for the chase, sullenly retire from the field and refuse to associate with their bristly competitor in venery. Possibly the hereditary and ineradicable enmity between the dog and hog as domestic animals may be a survival of the fierce antipathy which is known to exist between the wolf and the wild boar. In Burmah the ringed snake is trained for the chase, and is especially serviceable in flushing jungle-cock, since the reptile can penetrate the thickest underbrush, where it would be impossible for a dog or a falcon to go.

The tamability of an animal is simply its capability of adapting itself to new relations in life, and depends partly on its mental endowments, but still more upon its moral character. It is quite as much a matter of temperament and social disposition as of quickness of understanding. The elephant, dog, and horse among quadrupeds, the beaver among rodents, and the daw and raven among birds, are, for this reason, most easily tamed, and show the most marked and rapid improvement in consequence of their daily intercourse with man. Intellectual acuteness without the social affections and kindred moral qualities rather resists than facilitates domestication. Of all domestic animals the cat was the most difficult to tame, and it needed the patience and persistence so strongly characteristic of the ancient Egyptians, sustained by religious superstition, in order to accomplish this result. Even now the cat, although extremely fond of its home and capable of considerable attachment to persons, has never been reduced to strict servitude and become the valet of man like the dog, but has always remained to a certain degree what it originally was, a prowling beast of prey.

Barking in dogs is a habit due to domestication. The wild dog never barks, but only howls, like the Himalayan buansu, or merely whines, like the East Indian colsum; and the domestic dog reverts from barking to howling when it relapses into its primitive state. Wagging the tail is another mode of expression which the dog has acquired through association with man. It is well known, too, that a dog which has been reared by a cat adopts many of the habits of its foster-mother, such as cleaning itself with its paw; by continuously pairing such dogs and rearing them under like influences it would be possible to produce a canine species with feline traits, which should become permanent and transmissible.

A recent writer, Dr. Leopold Schutz, professor in the theological seminary at Treves, who may be taken as an extreme representative of the old orthodox school of zoöpsychologists, maintains that animals do not think, reflect, form purposes, or act with premeditation of any kind, have no freedom, no choice,

no emotional or intellectual life of their own, but that a higher power performs all these operations through them as cunning pieces of mechanism. The bird sings, according to this theory, without any personal pleasure or participation in its song; it sings at a certain time and can not help it, nor is it able to sing at any other time. The living cuckoo is as automatic as the wooden cuckoo of a Black Forest clock, and under the same mechanical compulsion to sing its song when the appointed hour arrives. Altum, in his book on bird-life (Der Vogel und sein Leben, Münster, 1868), infers from the fact that a bird sings more in the pairing season than at other seasons of the year, that its song is a "natural necessity," in which it takes no individual pleasure. But this conclusion by no means follows from the premises. The song is a means to an end, and has for its final object sexual attraction and selection. One would surely not be justified in inferring that a woman who dresses well, chiefly in order to gratify her husband or her lover, finds no individual æsthetic satisfaction in a fine gown; or that a man goes a-wooing from "natural necessity," and gets no entertainment out of courtship.

Prof. Schutz's doctrine that animals are mere puppets, whose movements are determined by the direct intervention of higher powers, seems to have been derived from what is recorded of the relations of these creatures to holy men in the legends of the saints, rather than from a scientific study of the book of Nature; his point of view is not that of the zoöpsychologist, but that of the hagiologist.

The chief difficulty attending the investigation of mental processes in animals is that they can not express themselves in human language and explain to us their thoughts and feelings and the motives underlying their conduct. We are thus liable to misinterpret their actions and deny them many endowments which they really possess, just as the first explorers of new countries fail to discover in savages ideas and conceptions which are afterward found to characterize them in a remarkable degree.

We have happily rid ourselves somewhat of the ethnocentric prepossessions which led the Greeks, and still lead the Chinese, to regard all other peoples as outside barbarians; but our perceptions are still obscured by anthropocentric prejudice which prevents us from fully appreciating the intelligence of the lower animals and recognizing any psychical analogy between these humble kinsmen and our exalted selves.

TYPE-CASTING MACHINES.

By P. D. ROSS.

IN the composing-room of the New York Tribune some forty type-casting machines have been used for several years. The foreman informed me in October last that all the ordinary reading-matter in the Tribune was being "set" by these inventions, and expressed himself perfectly satisfied with the working of the machines. As a rule, he said, not one of them was out of order, and on the average each did the work of three fair compositors. In a printed circular issued by the patentees of the machine, the foreman, Mr. G. W. Shafer, declares that, compared with what the same amount of setting would cost if done by hand by compositors, "the machines save the Tribune office sixty per cent—probably more."

My object in visiting New York at that time was to look into the type-casting process. The result of the visit was a conviction that the problem of setting type by machinery has been solved. Small printing establishments may not benefit from it for a few years. Large establishments, particularly large newspapers, may profit at an early date. The New York papers are looking to this. The business manager of the World, Mr. G. W. Turner, informed me that he had ordered one hundred machines. In the composing-room of the Brooklyn Standard-Union I saw six machines working. I was informed that orders for machines had been placed by the New York Sun, Herald, Times, and Mail and Express. Outside of New York, the Louisville Courier-Journal uses thirty machines, and says it saves fifty per cent of what hand composition used to cost it. The Providence Journal uses twelve machines, and claims to save two hundred and fifty dollars per week. The Chicago News says it is saving fifty per cent in the cost of composition. These are only some of the newspapers which state that they have been using the machines regularly and successfully during the past year. Four machines ordered by the Canadian Government have been used in the Government Printing Bureau at Ottawa for some months, and, in reply to a question in the House of Commons recently, the Secretary of State, Hon. J. A. Chapleau, said that they were satisfactory and economical.

All this goes to show that the type-casting principle has obtained a practical footing in the market. In discussing the subject, I propose to confine myself as much as possible to my personal experience and investigations. If I state anything which I do not know personally or have not been told at first hand by disinterested persons, I will give the source of my information.

WHAT TYPE-CASTING IS.—Before describing the type-casting principle, allow me to review briefly the process of type-setting by hand.

In this process the operator, technically called a "compositor," has before him an oblong frame (or "case") divided into a number of small open boxes. One box contains the a's, another the b's, another the numeral 1's, another the numeral 2's, and so on. In his left hand the compositor holds a little steel receiving box, called a "stick." With his right hand he picks out from the "case" the letters he requires to form a word, and puts them one by one in his "stick." The stick is the same width as the column of his newspaper. Toward the end of each line in his stick he has to pad out the line with lead slugs so as to exactly fill the width of the stick; this is called "justifying." When he has a certain quantity of reading matter in his stick, say one tenth of a column in length, he transfers the type to a "galley" or long "stick." By and by, when the galley is filled up, the type in it is transferred to the large receiving form called a "chase," in which the columns of the newspaper are made up to be placed on the printing-press. Such, very roughly described, is the process of type-setting by hand.

After the paper is printed the compositor must pick out all the separate letters and numerals from the columns of type, and put them back in the proper boxes in his "case." This is called "distributing." The "distribution" occupies about one fifth of a compositor's whole working-time.

In all this, civilization is to-day where it was five hundred years ago, and almost where the Chinese were two thousand years ago. Alone of all the great inventions of man, type-setting has stood still from its birth until now. In war and in commerce, on our farms and in our workshops, in travel and in our homes, almost every mechanical process, once slowly and laboriously effected by manual or animal labor, has been quickened generation after generation by new appliances or inventions, save and except the work of type-setting That is as slow now as when Coster or Gutenberg did the first European type-setting early in the fifteenth century. Printing has otherwise moved with the rest of the world. Our printing-presses, our power, our folding and pasting machines, all are wonderfully improved. Nothing in all the world has developed more marvelously than the printing-press. But type-setting has stood still. The ordinary composing-room of to-day can work no faster and no better than the composing-room of the fifteenth century.

With the type-casting machine should come a new era. The operator needs only the intelligence which is required in a good compositor. He does not require more than one tenth the train-

ing. Thus equipped, he can, I believe, do steadily and regularly the work of three fair hand compositors. He does not handle type; has no "stick"; is not required to do any justification nor any distributing. He sits in front of a machine and works a key-board and a lever, and the machine does everything else.

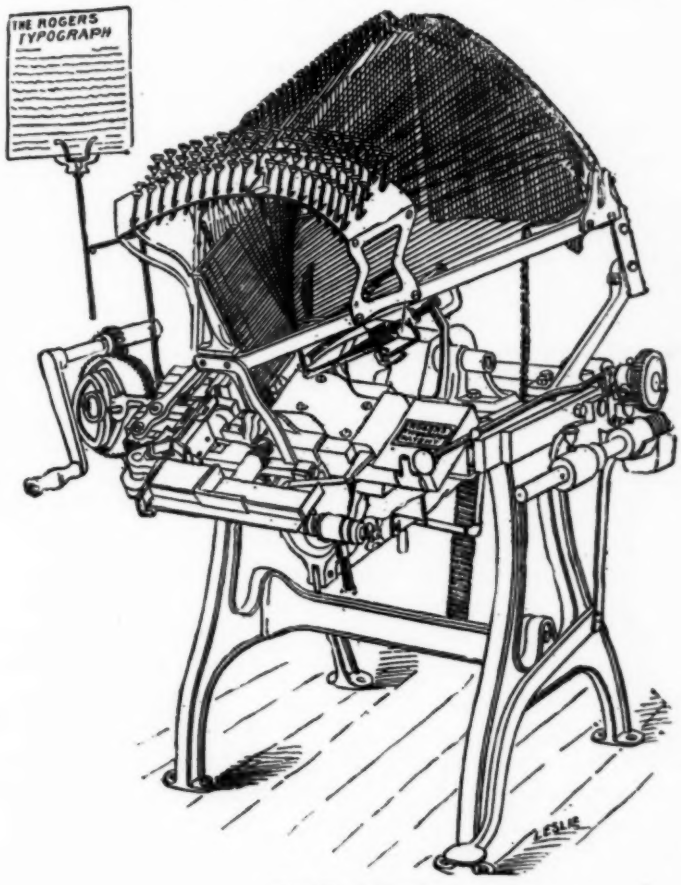
Now to outline the working of the type-casting machine. A key-board similar to that of a type-writer fronts the machine. There is a key for each letter of the alphabet. The operator sits in front of the key-board. Let us suppose that he wishes to set the word "new." He touches the key *n*. The touch on the key releases from a magazine in rear of the machine a mold, technically called a matrix, for the letter *n*. The matrix, which is of brass, slides down into a receiver near the key-board. Next, the operator touches the key *e*. A matrix for the letter *e* is released, and slides down alongside the letter *n*. The operator touches the key *w*. A matrix for *w* comes down and ranges itself alongside *e*. Now, in the receiver we have, what?—the word *new* in type? No, nothing of the kind. We have three little brass molds standing side by side, from which, if we poured molten metal into them, we would get the word *new* in a solid cast. But there is no type. The machine knows nothing of type whatever, though, for convenience' sake, we are calling it at present a type-casting machine.

But the time is not come to put molten metal into the three little molds or "matrices." An entire line should be set, not merely a word. Suppose the line is to be, "new things come to pass." The operator proceeds to touch key after key for the successive letters until the matrices for the whole line are ranged side by side. Now at this point comes in what was for years the great problem in type-casting by machinery. As the end of a line of matrices or type is approached, it may not be possible to fit in an even word or syllable. Padding, or "justifying," becomes necessary. In setting by hand, the compositor does this with little lead slugs, called "spaces," inserted between words. How is this to be done by a machine? Inventors long stuck at it. But they have found out how. The process is simple in action, though difficult to describe without a model. Roughly speaking, the "spaces" or slugs which are used between each word in the line of matrices are compensating wedges, the bottoms of which project below the matrices. When the line of matrices requires "justification," a touch on a lever by the operator causes the bottoms of the compensating wedges to be struck by a cross-bar, which forces the wedges up between the words until the line is solidly filled out.

The line of matrices or letter molds is then ready to receive a cast. Where is the molten metal? It is in the machine. This

wonderful apparatus has a furnace for a heart and a melting-pot for a stomach. The furnace, consisting of a series of gas-jets, and the melting-pot, are in the lower part of the body of the machine. In the pot, stereotype metal is melted. The pot is not very large, because fresh metal may be put into it at any time when needed. The same metal may be used over and over again as often as desired; it does not deteriorate.

A jet of molten metal is thrown into the matrices by a force-pump worked by the automatic action of the machine. The metallic fluid, hardening almost in an instant, a property of



THE TYPOGRAPH.

stereotype metals, forms a solid cast or bar, on the face of which is the line "new things come to pass," and the machine automatically ejects this cast or bar of letters into a receiver, into which it is followed line after line by new casts with wonderful rapidity, until in a short space of time a column of reading-matter in bars is ready for the press. The speed of the machine is measured by

the speed of the operator at the key-board. It can work as fast as he can.

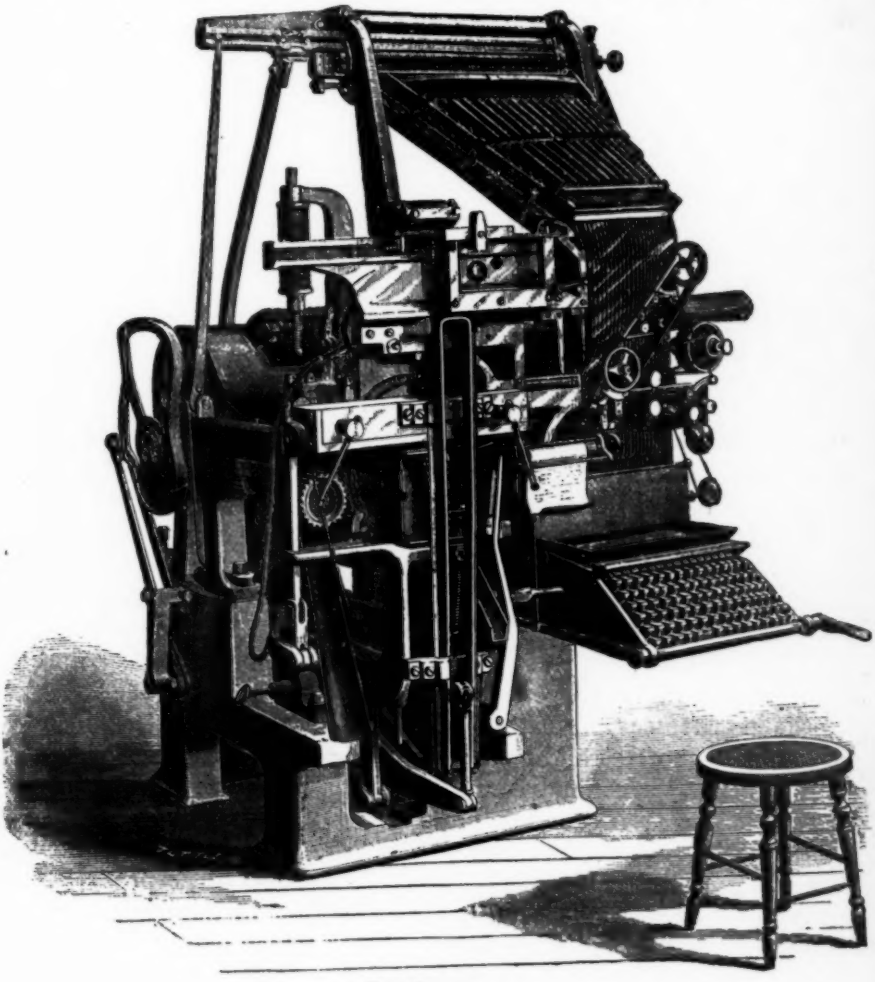
When a line of matrices has been utilized, the matrices must be returned to their channels ready for use again. This is accomplished by ingenious contrivances as soon as the cast has been made. The matrices being thus promptly returned, there is only need for a few of each letter. Thus a few dozen of the little brass molds do the work which in type-setting by hand needs a stock of from forty to fifty pounds of type.

THE RIVAL PATENTS.—There are two type-casting machines on the market. These are the Mergenthaler or Linotype, and the Rogers or Typograph. The Linotype weighs a ton, covers floor space about six feet by six, stands seven feet high, and is sold for $3,000, or rented for $500 a year. I have seen an expert operator set at the rate of nearly eight thousand ems per hour on it from a phonograph communicating with his ear. The proprietors claim a regular practical speed of over four thousand ems an hour, which is four times the speed a good compositor averages by hand, if we include the time he must take for distributing. On the Linotype, the first time I ever touched a key-board, I set one hundred and fourteen ems of strange copy in six minutes, or at the rate of eleven hundred and forty ems an hour.

The Typograph weighs four hundred and fifty pounds, covers floor space four feet by four, is four feet six inches high, sells for $2,500, and rents for $365 a year. The proprietors claim a regular practical speed of three thousand to thirty-five hundred ems per hour. I have set one hundred and fourteen ems by the Typograph in nine minutes. At the end of each line the operator at the Typograph must stop to throw back the cap of the machine, a movement which restores the matrices to their magazines. The proprietors of the Typograph claim that it can work as fast as will ever be practically possible on any machine. In other words, they think that human beings will not be physically capable throughout a whole working day of requiring as great a steady speed as the Typograph can give.

The Typograph was submitted to a severe practical test in September, 1890, by the New York World. An eight-page section of the Sunday World, September 28th, was set by one machine working continuously day and night for one hundred and nineteen hours and thirty-five minutes, or nearly a week. The object of the test was to ascertain how the machine would bear a continuous steady strain. Three operators took eight-hour shifts at the work. The machine—I was informed both by the business manager of The World, Mr. Turner, and by one of the operators, the foreman of The World composing-room—stood the test almost perfectly. I measured the amount of setting done. It came to

one hundred and fifty-six thousand ems of minion. As the machine was worked one hundred and nineteen hours, this shows an average speed of only thirteen hundred ems per hour. At first sight this might seem disappointing. There were reasons why it was not so. The three operators were compositors, and had had only three or four weeks' practice on the Typograph. Owing



THE LINOTYPE.

to faults of the motor used to run the machine, it had to be worked by hand-power one quarter of the time. The three operators not only ran the machine, but they read the proofs, made the corrections, set the headings, and made up the "forms" ready for the press. Finally, the machine lost several hours' work through a fault in a casting. Taken as a whole, it seems to me the test was a conclusive proof of the practical success of the Typograph.

TYPE-SETTING BY MACHINERY.—Type-casting is quite different from machine type-setting. Before contrasting type-casting with ordinary hand type-setting, it may clear the way to outline the principle of machine type-setting.

The type-setting machine has a reservoir of type, instead of a magazine of matrices as in the casting-machine; but, unlike the matrices, which return to their magazine the moment a line is cast from them, the type must go the whole way to the printing-press. Otherwise, the action of the type-setting machine is somewhat similar to that of the casting-machine. The type-setting machine is also worked by an operator at a key-board. When the operator touches a key, a type is released, just as a matrix is in the casting-machine, and slides into a receiver, where it is joined by other successive letters until words and lines are formed. As type is directly used, there is no furnace or melting-pot about the machine. This is the only advantage it has over the casting-machine, while compared with the latter it has serious drawbacks.

The type-setting machine seems to be a practical success, and an improvement on type-setting by hand; but, if for two reasons only, it is doomed to be superseded by the casting-machine. 1. It requires a heavy stock of type instead of a few matrices. 2. At least two attendants are required to each machine, one to operate the key-board, the other to justify the lines, attend to corrections and superintend matters generally, and to distribute the type again. Still, the business manager of the office in which the New York Forum is printed, informed me that through their use he is saving $1,700 a year in the setting of that monthly magazine, which does not require in a year as much composition as a daily paper in a month.

COMPARISON WITH TYPE-SETTING BY HAND.—In any considerable quantity of straight reading matter, type-casting machines as compared with hand composition should, if working successfully, effect a saving of from one fourth to one third the cost of setting. Moreover, the setting is better. Perhaps this contention is best illustrated by figures. Those which I propose to give are based on the conditions prevailing in Canadian newspaper offices. Let us suppose an office in which one hundred and twenty thousand ems of straight reading matter are set per day in minion type. To fix ideas, we may describe this roughly as equal to about twenty-five ordinary newspaper columns. Many of the larger city papers in Canada print just about this quantity of reading matter per day. The union rate paid compositors in Canada is thirty-three and a third cents per one thousand ems. One hundred and twenty thousand ems would cost, therefore, about $40 for composition, apart from the cost of the type, foremen, office, etc. Forty dollars per day would come to $12,000 per year of three

hundred working-days. Now, let us see what it would cost to do the same amount of setting by the type-casting machines. These are claimed by their proprietors to work at the rate of three thousand to five thousand ems per hour in regular use. Making allowance for the probability that operators could not keep up such a speed all day, that mistakes have to be corrected, and accidental stoppages might occur, we may admit that the machines can set an average of twenty-five hundred ems per hour during an eight-hour day, or twenty thousand ems per day each, which is little more than half what the inventors claim as practical. Six machines could at this rate set one hundred and twenty thousand ems per day. As already said, to set this by hand would cost $12,000. The cost of the machine work would be—

Six machines at $500 rent each	$3,000
Six operators at say $14 per week	4,368
Gas, say	1,000
Repairs, etc.	500
Total	$8,868

Or equivalent to a saving of $3,132 on the setting by hand, or over twenty-five per cent. The estimate of $14 per week as a fair rate for operators of the machines is not too low for a Canadian office. First-class compositors certainly do not average more.

As a further illustration, I may give the actual figures of cost of a composing-room with which I am familiar. The setting amounts to about sixty thousand ems in a nine-hour day, done by ten to twelve compositors. A number of the hands are paid by the week, and the straight setting costs only about twenty-five cents per thousand; or, for sixty thousand ems, $15 per day—equal for three hundred days to $4,500 per year. There is also a foreman at $14, an assistant foreman at $12, and a couple of lads at $3 each. These four, costing $32 per week, or $1,664 a year, do all the setting of space advertisements. There is $2,000 worth of type, costing for interest say $140 per year, and requiring renewal at the rate of say $400 per year, or complete renewal once in five years. The cost of the composing-room is therefore somewhat as follows:

Composition by hand	$4,500
Foremen, etc.	1,664
Cost of type	540
Rent, heat, light, etc., say	500
Total	$7,204

To set sixty thousand ems in a nine-hour day, or six thousand seven hundred ems per hour, would require say three type-casting machines, which at $500 rent would cost $1,500 per year, and the composing-room figures would be:

Rent of machines	$1,500
Three operators at $14	2,184
Foremen, etc	1,664
Gas for machines, say	500
Rent, heat, light, etc	500
Total	$6,348

The saving would apparently be some $856, or over twelve per cent, while less room would be required, cleaner and better work would be done, the labor better paid, and a higher class of operators employed. Later I will touch on some reasons why it might not be safe to depend on type-casting machines in so small a business. In a larger business there is little doubt in my mind that the use of the machines is preferable to hand composition.

Finally, it is much easier to learn to operate the type-casting machine than to learn to set type. To set type at the rate of a thousand ems an hour requires two or three years of constant practice. To set a thousand ems on the type-casting machine in an hour requires no previous practice. It can be done the first time a person touches a key-board. This seems a strong statement to make, but I have the best of reasons for knowing it to be true. I did it, as already described. Previous to making the attempt I had never touched a key-board but once, and that was a dummy-board. I had never touched a type-writer or any other instrument the use of which might qualify one for operating the type-casting machine. Being in the rooms of the Linotype Company in New York recently, I asked and received permission to try the machine; and picking up a printed clipping from which the operator had been setting, I went to work and in six minutes set one hundred and fourteen ems, equal to one thousand one hundred and forty ems per hour, stopping because the clipping then ended. I repeated similar experiments on other machines subsequently, with much the same average result. In short, I was able to do with the machine at sight and without practice what it would take me years to learn to do by hand. As to becoming expert on the machines, a number of operators whom I have questioned agree that from three to six months' practice enables one to attain a speed of three thousand to four thousand ems from ordinary copy.

In fact, as I have stated, the only limit of speed on the Linotype is the rate at which the operator can move his fingers. He can not work quite so rapidly as a type-writer, because at the end of each line of matrices he must stop to touch the lever which sends the line off to receive a cast. Supposing we allow twenty-five per cent of his time for this, which is surely a large proportion, we can get an idea of the possible practical rate of the machine by comparing it with the possibilities of a type-writer.

Upon a type-writer, a rate of sixty words per minute from dictation is not very high. The Senate Hansard reporters of Canada employ several type-writers who average from sixty to seventy words and over for considerable periods of time. Allowing the speed of the operator on the type-casting machine to be twenty-five per cent less, we have at least forty-five words per minute as the practical rate of the machine. This is equal to seven thousand one hundred and five ems per hour. As already said, I saw one man at the Linotype set for half an hour from a phonograph at a rate of nearly eight thousand ems per hour, and the setting was as "clean" as that of the average compositor.

Summing up the comparison between hand setting and machine casting, I find: 1. The machine is much more easily learned. 2. No type is required. 3. Less space and fewer hands are needed in the composing-room. 4. Setting is cleaner, and probably one third cheaper. 5. Justification is automatic and perfect. 6. By changing the matrices, which can be done in half an hour, a different style of type becomes available. 7. "Leading" can be done much more quickly. 8. There is no "pi-ing," or mixing up of type. 9. Fewer typographical errors are likely. You do not have inverted letters, nor mistakes due to the type having been wrongly "distributed" in the case, which are a source of frequent typographical blunders.

Drawbacks and Possible Complications.—It will be asked, How is it that these remarkable machines have not at once sprung into popularity ?—so cheap, so rapid, so easily learned, so economical! How is it that so little has been heard about them ? Well, the patents were only perfected last year, and the machines are not yet being made fast enough to supply the demand. Meanwhile, there are many possible complications, the fear of which must cause the average printing-office to hesitate to try the machines. 1. The machines require power to drive them effectively. The failure of power for any reason would seriously interfere with them, although they can be driven by foot-power in an emergency. 2. They require gas or gasoline for their furnaces; the failure of the gas from leakage, or cold, or accident, would stop the machines. 3. The molten metal in the melting-pot must always be at a tolerably even temperature; otherwise the casting is bad, perhaps impossible. It is claimed that this difficulty has been overcome in the Linotype, and that the temperature of the molten metal is automatically kept at a temperature varying not more than 10° Fahr. A column of mercury is connected with the melting-pot, and when the temperature causes the mercury to ascend beyond a certain point, it lowers the gas-jets which supply the heat. When the mercury descends below a certain point, it turns on the gas more strongly. 4. The machines are composed of many

parts, and if they get out of order in a town in which expert mechanics are not at once available, their usefulness is gone for that day at least. 5. They can set only straight reading matter, so that advertisements, display headings, cross lines, italics, etc., must be set by compositors. 6. If a mistake of a letter is made in setting by the machine, the whole line must be recast, unless (which is not likely) the mistake is noticed the moment it is made and the operator stops to rectify it by changing the matrix. However, a whole line can be reset and recast almost as quickly as a compositor can correct by hand a mistake in a type letter. 7. It is a more serious drawback that if, in correcting proofs, it is desired to insert additional words, a number of lines may have to be recast. 8. The matrices in which the casts are made are possibly liable to wear a little, and so to soon make bad casts. Of course this can be remedied by getting new matrices, which are not expensive. 9. In a small office where two or three machines might be employed, there would probably be only two or three expert operators; if one took ill, the machine would become almost useless for the time being.

PRESENT PRACTICAL AVAILABILITY.—A small printing-office is hampered in many ways with regard to the use of machines, nor can it safely, at present, take the chances of break-downs. Where only three or four machines can be used, the stoppage of one means a loss of twenty thousand ems of setting per day. That is serious enough; but if the cause of stoppage should affect all the machines, there must be a business dead-lock, because small concerns, or rather concerns in the smaller centers of population, can not at slight notice secure a staff of compositors to replace the machines, or arrange for publication elsewhere. Even, therefore, were the machines being manufactured as fast as desired, it is questionable whether they would find a market at present outside the large cities where expert mechanics can be had to attend them at a moment's notice, and where arrangements for special help or special publication can be made in an hour, if necessary. But I think that in any office setting one hundred thousand ems a day, or over, it would pay the proprietors to at once procure machines sufficient to do at least half their setting, retaining a certain number of compositors with them. I can see no reason why this should not be a fairly safe experiment and a financial success.

The machines are available on a very liberal basis. Either company leases them at a moderate rental, agrees to take them back if not satisfactory, to keep them in repair while used, and to replace them with new machines in case of improvement of the patent.

The typographical unions admit that the machines must be

accepted as a practical fact. The International Typographical Union, at its last annual meeting in the United States, recommended its subordinate unions, in cities in which the machines come into use, to prepare a scale of prices for the work done, and to urge that union compositors be employed as operators. This is a sensible acceptance of a new order of things.

In conclusion, this is to be observed: There are theoretical objections to the machines in many small details which have not been touched on in this article, partly because I wish to present a clear general idea of the subject unencumbered by trivialities; partly because to handle them would require complicated and technical descriptions likely to confuse those who have not seen the machines, or who are not familiar with type-setting or stereotyping methods and appliances. With regard to such possible objections, it should be remembered that the type-casting principle scarcely now requires to defend itself against fanciful opponents. It has been tried, and not found wanting. As was stated at the outset of this article, a large number of Linotypes have been successfully employed for years in the composing-room of a leading New York paper. I have tried to deal with the chief possibilities of failure in the machine, and it has been noticed that these possibilities seem to be chiefly in connection with printing establishments of limited extent and means. Few of the drawbacks, it appears to me, would be serious in a large office employing machines, and located in centers where the prompt assistance of expert mechanics can be had, and my conviction of this is borne out by the New York Tribune's experience. Such a test as the Linotype has received in that office during five years is the most conclusive answer to technical or theoretical objections to the principle of type-casting The real problem with a publisher should be, not whether the machines are a success when used on a large scale, but whether his own business is large enough to justify him in introducing them into his own office. To use an exaggerated illustration, there is no question but that a steam-locomotive is an infinitely more useful, powerful, and, on a proper scale, more economical affair than a wheelbarrow; but a laborer building a bit of roadway may do better with the wheelbarrow.

MR. ROBERT T. HILL has observed, near the springs and water-holes of the Cretaceous of central Texas, many workshops where the Indians manufactured spears and arrow-heads. Near an old Comanche trail in Travis County almost every flint seems to have been broken or tested. In evidence that the implements have been manufactured in the present century, the author adduces the facts that they are always found on the surface, and that the Indians have actually used them in their warfare with the white men.

BREATHE PURE AIR.

By the Rev. J. W. QUINBY.

ONE of the saddest sights of our civilization is the spectacle of disease and pain which confronts us on every side. It is rare indeed to find even an individual perfectly well, to say nothing of families and communities. But why is it?

Barbarians and savages do not so suffer. May it not be, in part, because civilized communities do not sufficiently avail themselves of the sanitary influences of the air and light? It is in the hope of helping to answer this question that the following notes of personal experience are herewith given.

A few years ago I read an article in the Popular Science Monthly which seemed to prove the value of pure air as a preventive of "colds." The theory suggested was that colds may be caused by the loss of a certain equilibrium between the oxygen in the lungs and the carbon in the blood. It is true that this may follow overeating, and so overcharging the blood with food elements; but more frequently, it was thought, the lack of pure air.

By acting upon this theory almost incredible results were said to have been reached. The writer of the article alluded to claimed that he had easily brought himself into a condition in which it seemed impossible to take cold. He could sit in thin clothing in winter at an open window. The ordinary causes of colds, such as wet feet, overheating, and the like, seemed powerless to produce their usual results.

With these statements in mind, I remembered some curious facts of my own experience in the army in 1862 and 1863. I was not strong, and indeed was hardly fit to be in the army at all. And when I found myself exposed all day long to a steady rain, and at night to the outdoor air, with no fire, no change of clothing, no shelter but a canvas covering open at both ends, through which the rain dripped constantly, it seemed certain that the "death o' cold" so often predicted must surely follow. Why it did not follow was more of a mystery then, however, than it is now. For I was in a place where the art of man no longer excluded one of the prime principles of health. I breathed pure air because I could not help it. During a service of fifteen months, with severe exposures, but fresh air constantly, the same immunity from colds prevailed. I remembered, too, that when I came home from the army the blessing and the curse—at least one of the curses of civil life—came back together. I had comfortable rooms to eat, breathe, and sleep in on the one hand, but very soon colds, sore throats, and related troubles on the other. This was the second count in the argument for pure air.

Finally, after nearly twenty years of suffering according to the common lot of man, I resolved to try the pure-air cure, and from that time to this the windows of my room have been open almost constantly day and night. The result was immediate and striking, and for the last seven years I have not had one serious cold. My sore throats are wholly a thing of the past, and certain other physical derangements not usually associated with colds have also disappeared.

Like others, I have often to spend hours in crowded rooms. It sometimes happens after such an "exposure," as I prefer to call it, that I suffer for a day or two from a "head-cold." But in every case so far it has proved to be entirely superficial—a natural and easy throwing off of the poison contracted in that crowded room, followed by no serious effects whatever.

At this very moment in the house where I live there are twelve persons, every one of whom, except myself and one other, is suffering from the effects of a cold. It certainly does look as if the exemption I enjoy is due to the exceptional privilege of the pure air to which I constantly treat myself. Perhaps it would help the argument to state that nearly all of my father's large family died of consumption.

It should be borne in mind that the difference between the air of an ordinary room in which people live and that of the air outdoors is far greater than is generally supposed. Do but think of the emanations that constantly proceed from every object in such a room—carpets, walls, and draperies. People say: "Oh, yes, we believe in ventilation. We open the windows in the morning and let the air draw through; and at night we open the doors of our sleeping-rooms. We believe in pure air." And I feel like saying to them: "My dear friends, you know no more of really pure air than the blind mole down in the ground knows of sunlight."

I would not by any means advise persons who have been living in a close atmosphere to suddenly sit or sleep in the draught of an open window. It is only by degrees that such changes can be made with safety. But by degrees they can be made, and why might not most people begin at least to make them?

In the town where I live, in Massachusetts, a new system of ventilation required by the State has recently been put in operation in the high-school building. By means of it thirty cubic feet of air, it is said, are furnished to every pupil every minute. It seems to me this forward step in so vital a matter should be heartily approved by every lover of humanity.

Meanwhile, it is painfully apparent that multitudes of people, sick with constantly recurring diseases of the lungs and related parts, continue to breathe the old foulness. Is it not worth while

to make some effort to change this condition of things? Perhaps half the money now spent on superfluities, if devoted to a better system of ventilation, might very sensibly improve the health and increase the happiness of the community.

DRESS AND ADORNMENT.

IV. RELIGIOUS DRESS.

By Prof. FREDERICK STARR.

UNDER this subject we shall consider a variety of different matters—the dress of religious officers; the dress of worshipers; the dress of victims; the garb of mourners; amulets and charms; and the religious meaning of mutilations.

In any society we need *to know* four individuals only—the babe, the woman, the priest, and the dead man. If we know these, we know the community. The ethnographer usually seeks for the average man in any tribe; we believe he would better seek to know these four. Of the four the priest is usually the most remarkable. What an influence the shaman or the medicine-man wields in every community where he exists! His power is largely due to the terror which he causes, and to add to this he makes use of every auxiliary. Thus in his dress he aims at the wild and grotesque. By it he seeks to mark himself off as distinct from common men, and, although it may often be rich and costly, it must at the same time strike terror. The Kaffir sorcerer wears the ordinary kilt, but puts a gall-bladder in his hair and winds a snake's skin about his shoulders. A "queen of witches" wore large coils of entrails stuffed with fat about her neck, while her hair was

Fig. 1.—Necklace of Sorcerer. Zululand.

stuck over in all directions with the gall-bladders of animals (Wood). In any collection of articles from Alaska tribes a large proportion of the specimens will be garments or paraphernalia of the shaman. A Tlingit shaman fully dressed for his professional duties is a striking and terrible sight. Over his shoulders he wears a neat robe of dressed skin, to which are hung

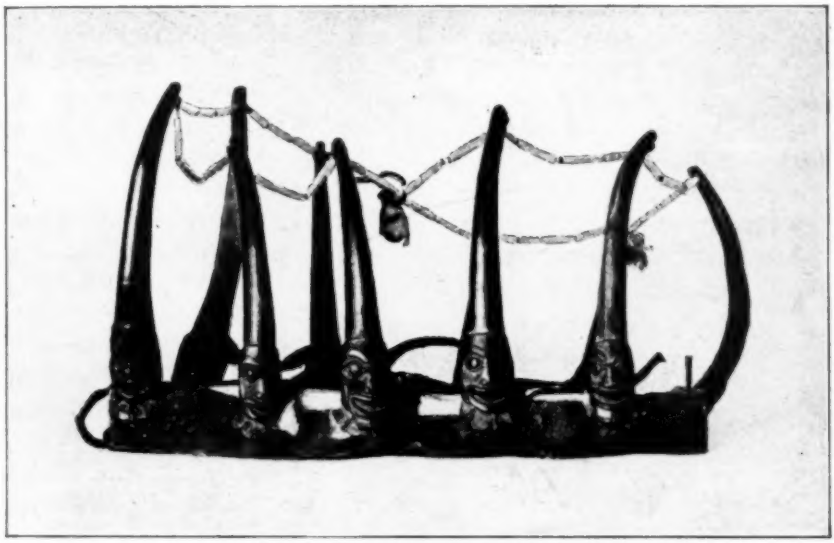


FIG. 2.—SHAMAN'S CROWN. Alaska.

the beaks of puffins, ivory charms, and jingling bits of metal. The charms are many of them neatly carved, and possess great spirit power in the cure of disease and the driving out of witches. A waist robe of the same material is adorned in the same way. Upon his head the shaman wears a crown of horns. These crowns are endowed with great spirit power. They are particularly interesting also as an unusually fine example of our old law—that old patterns are copied in new materials. The oldest type of these crowns was made from mountain-goat horns. These were simply carved with some design at base and were then attached to a head-band—the upper ends of the horns being connected with one another by a sinew cord. From ten to fifteen horns were used in a single crown. Later this type was copied in mountain-sheep horn and in wood—the material being carved out into little bodies, like the horns of the mountain goat in size and shape. Still later copper was rolled into horn-shaped cones, which were then connected in the same way. Over his face the shaman may wear a wooden mask skillfully carved with grotesque designs. These vary infinitely, but each part usually has its own meaning and spirit power. Often there was worn a head-dress of human hair. In the hands the shaman carries carved rattles

which make a loud noise, or carved wands of wood or ivory, powerful in healing or in witchcraft. It must be noticed that here every article has spirit power, and all or nearly all are calculated to inculcate feelings of terror or dread. There are some special articles, at times worn or carried by the shaman, which are very interesting. Among them are the curiously carved hollow bone tubes, used by the Haida shamans, into which the soul of a sick man is tempted and kept prisoner until it is restored to him upon his recovery to health. Every Tlingit shaman would carry also a scratcher of stone or bone, carved neatly, which he uses in treating the sick. It would be unlucky—disastrous—for him to touch the patient with his hand, but the scratcher may touch him without damage.

Turning from such savage garments to the dress of religious officers in civilized communities, we no longer find the chief design to be production of terror, but rather to impress by grandeur or magnificence. Of course, the *fundamental* idea in both is the same—to mark off or distinguish the priest from the layman. In the vestments of priests we find numerous cases of *survival.* What is meant by a "survival" in religion is well shown by the sacred fire of various peoples. Among the Sacs and Foxes matches made by white men are commonly used for the production of fire. On the occasion of religious ceremonies, however, the priest kindles a fire by friction of pieces of wood, using a spindle of cedar rapidly whirled by a bow between two boards of the same kind. Such fire is sacred, and is supposed to come direct from heaven. It is, we think, perfectly certain that anciently these Indians used the fire-drill as their only means of kindling fire. As better means, such as flints, were found, the old drill passed out of every-day use, but it lingered on in religious rite, and still survives. In the same way, in Japan to-day, we are informed by a Japanese friend, the Buddhist priests still use the flint

FIG. 3.—DANCE-RATTLE. Alaska.

and steel in rites, although the common people use matches. What the Indian medicine-man in Iowa and the Buddhist priest in Japan have done in the matter of fire-making, the priests of the Roman and Greek churches have done in the matter of dress. They have brought down the past into the present. The garments of the priesthood, of the acolytes and of the choir-boys in the cathedral, is the civil dress of ancient Rome —modified, it is true, and symbolical in its modification, but still recognizable. It is the old southern type of dress, preserved by the second great conservative element in society — the Church — just as it has been by that other conservator, woman.

FIG. 4.—CARVED SPIRIT-WANDS. Alaska.

In many parts of the world mendicants and fakirs are numerous. They are men who on account of their piety expect to be supported by their more industrious but less pious fellows. Such dress in a way to be readily recognized. In the garb they wear two ideas are embodied: (1) individualization; (2) extreme simplicity symbolical of the poverty of the mendicant.

Another sort of religious dress is that worn by the worshipers of some special divinity by members of religious orders and by participants in some religious service. These are too numerous and varied to be more than mentioned. In some of these cases the dress is symbolical; in many the symbolism has been lost. Monastic orders have their characteristic dress, distinguishing them alike from the world and from each other. Shakers, Quakers, and Dunkards all present examples of this kind of dress. The choir-boys in the cathedral and the acolytes might perhaps be better mentioned here than in the preceding group. Matthews, in his descriptions of Navajo ceremonies and dances, describes carefully the way in which the participants dress or are painted. Many of the masks from the South Sea Islands are used only in religious or society dances, and are properly a part of religious

dress. The same is true of many of the masks of North American tribes. Similar in idea are the curious and often really beautiful neck-girdles of red cedar bark worn by the secret religious organizations of the Kwakiutl and their neighbors in the far Northwest.

Somewhat akin to dress worn by worshipers and servants are those garments worn by victims who are to be sacrificed to the gods. At Teotihuacan in Mexico there have been and still are found great numbers of neatly made little terra-cotta heads of human beings. These are exceedingly various in design, the differences being most marked in the head-dresses. There is considerable uncertainty as to the purpose of these little heads, but Mrs. Zelia Nuttall has written an article wherein is offered an explanation that seems plausible. She suggests that they were buried with the dead, and that the head-dresses represent those worn by victims for sacrifice. That such victims were differently adorned for different gods is certain, and it may be that these pretty little relics really give representations of the way in which they were dressed.

Some time perhaps civilized peoples will give up the wearing of mourning for the dead. Why should any men or women force their private griefs upon all about them? Why increase the dolefulness of death? No doubt many who wear black would say that they do so from respect for the dead. Is it not in reality because fashion dictates it? Mourning dress is nothing new, nor is it confined to civilized races. Nor is the color of mourning a fixed thing. Black is very widely used, but some peoples use white. In New Zealand old people paint themselves freely with red ochre and wear wreaths of green leaves. Besides the wearing of a peculiar garb or of a special color to show grief, the mourners may disfigure themselves, or they may wear some relic of the dead friend. The curious practice of cutting off joints of the fingers is wide-spread. Among some American tribes, among Australians, Africans, and Polynesians it is a sign of grief. The Fijians used to chop off finger-joints to appease an angry chieftain, or for death of a relative, or as a token of affection. In Tonga finger-joints were cut when a superior relative was ill. In all these cases pres-

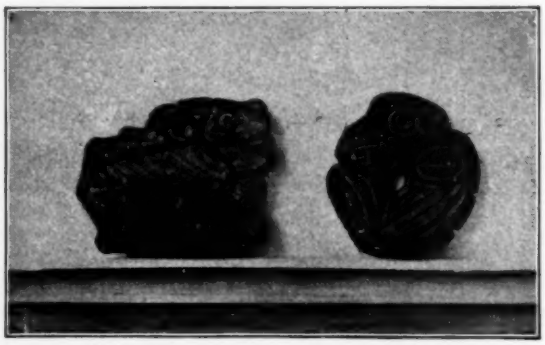


FIG. 5.—CARVED STONE CHARMS. Alaska.

ent grief did not blind the mourner to future convenience, and the joints cut were usually from the fingers of the left hand. In the Andaman Islands, when a child dies it is buried under the house floor and the building is deserted for a time. Finally, the family returns; the bones are dug up and the mother distributes them among friends as mementoes. These bits of bone are generally worn as parts of necklaces. In Tasmania and Australia portions of the dead are prepared with some care and worn as sacred and loved objects. Thus the zygomata are broken from a child's skull, sinews of kangaroo are passed through the orbits, and the whole is worn about the mother's neck. A lower jaw may be carefully and neatly wrapped with sinew cord from one condyle to the other and supplied with a suspension cord. Long bones, entire or partial, were wrapped and worn in the same way. These objects were all highly prized, and Bonwick says, "So many skulls and limb bones were taken by the poor natives when they were exiled, that Captain Bateman tells me that, when he had forty with him in his vessel, they had quite a bushel of old bones among them." These were in Tasmania, but similar relics abound among the Andamanese. In Australia drinking-cups were made from the skulls of the nearest and dearest relatives and carried everywhere. The lower jaw was removed, the brain extracted, and the skull cleaned; a rope handle of bulrush fibers was added, and a plug of grass was put in the vertebral aperture. All these may be considered as examples of *mourning dress.* There has also been a great variety of dress for the corpse itself. To describe such dress in any detail would be too much. Black is often used for shrouds. In the Tales of Hawaii, as narrated by King Kalakaua, frequent reference is made to the wrapping of the dead in the black *kapa.* In the Society Islands the dead chief is laid out in a special dress of shell.

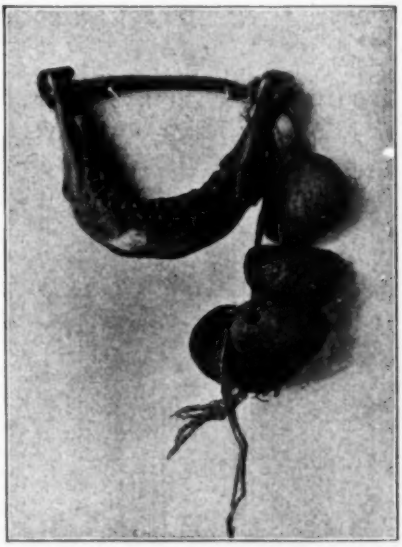


FIG. 6.—DANCE ORNAMENT FOR ARM. Made from human jaw-bone and empty nutshells. New Guinea.

In connection with relics of dead friends used as a part of costume, it may be pertinent here to refer to curious preserved heads found among various tribes. They may be simply the heads themselves, as trophies of war or reminders of friends, or they may

be masks made in part from the heads of the dead. The former are hardly a part of dress; the latter are. Both kinds will be considered. The Dyaks of Borneo are famous "head-hunters," and often prepare their trophies with great care. Barnard Davis had several specimens in his great collection, and he describes them in his Thesaurus. One was a whole skull; the lower jaw was stained inside to a deep red; it was fastened to the cranium by rattan; light, soft wood was fitted in the places of the teeth, into the nostrils, and into the ear-holes; other inequalities were filled with red-brown resin. The entire skull was covered with tin-foil; two cowrie-shells made the eyes; a small tuft of beard was made of stiff black hair; on the vertex and sides of the calvarium an ornamental, regular, and symmetrical device was cut through the tin-foil and painted red. These heads vary greatly in pattern and treatment. They were kept in head-houses, and were looked upon as treasures and as sacred objects. In the Solomon Islands, the Marquesas, and New Zealand we find heads preserved for one or another reason. Among the strangest of these most curious relics are the heads prepared by the Jivaros of South America. These are trophies of war. The heads are cut from the bodies of slain enemies; the brain and bones are removed through the neck; the whole head is then shrunken down. The result is a strange, diminutive, black head, with abundant and long hair, and with features all preserved, but so small as to be hardly recognizable as those of a human being. In all these Jivaros' heads the lips are sewed together with cords, and in some cases spiked together in addition. If Bollaert is to be trusted, this is done in order that the head may not answer the abuse that is heaped upon it at times! In the same part of the world, among the Mundurucus, are other interesting preserved heads. These are of full size; they are partly shaved; ornaments of feathers are hung at the ears; the eye-sockets are filled with black gum, into which are inserted bits of shell. These heads are apparently those of friends, not of enemies. In some respects akin to these real preserved

FIG. 7.—DANCE-MASK. South Seas.

heads are the very curious skull-masks from certain South Sea Islands. These are built up from parts of human skulls, pieced out with wood, cements, hair, and ornaments into horrid representations of faces. These are worn in dances and hence are true objects of dress.

The subject of amulets and charms would, of itself, furnish more material than could be used in our whole course of lectures. Scarcely any trinket or odd object exists that may not be worn upon the person "for luck," or to ward off danger or harm. All peoples use them. Savage, barbarian, and civilized man are alike here. Nubians are inveterate wearers of charms. Theirs usually consist of something done up in a red leathern case; the contents must not be known. *For what* will charms not be worn? I know American mothers who buy seeds — "Job's tears" — at drug-stores, to string them into a necklace to hang about the baby's neck to ward off eye troubles. The Bechuana mother strings beetles of a certain species and hangs them about the neck of *her* baby to help it in teething. Prof. Putnam found metacarpal bones of birds buried with babies in the little graves which he discovered under the hard clay floor of old house circles in Arkansas and Missouri. From analogy with modern Indian customs, he believes these were charms to help the child in cutting its teeth. We can not find that asafœtida is a specific for or a preventive of diphtheria, but we *did* find a small Afro-American who wore a little bag of it about his neck as a charm against the disease. Hundreds of Roman Catholic boys do not take off the medals they wear about their necks when they go in swimming, as these are a sure preventive against drowning. One of the most precious and beautiful amulets of history is that of which Moncure D. Conway tells us. It was a treasure from the past, owned by the Emperor Louis Napoleon III. It was set with a blaze of precious stones, the gifts of many princes. It descended to the Prince Imperial, who wore it as a watch-charm. He wore it when he was killed among the Zulus, and it is gone, no one knows where. Ah! if he had but known the rules

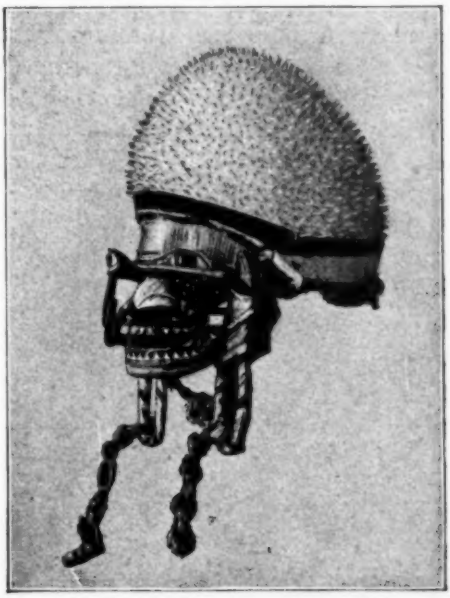


FIG. 8.—DANCE-MASK. South Seas.

of amulet-wearing among those people, and had worn it about his neck! No matter how precious it was, it would then have been left untouched. The dead of battle may be stripped of every garment or ornament but that about the neck. No doubt the priceless talisman of centuries is now the choicest decoration in some neck ornament of claws and teeth and feathers. The most interesting charm of the American Indians is the "medicine." This may be almost anything to which the superstitious barbarian attributes some supernatural power. Commonly it is the skin of some animal. In many tribes, the boy who is approaching manhood withdraws to the woods or to some lonely place, where he undergoes a long fast. Weakened by his abstinence, he falls into a slumber, in which he dreams of some animal. With recovered consciousness he hunts for an individual of this species, kills it, and with great care removes the skin. This is his "medicine," and to increase its power various articles may be inclosed within it. To part with his medicine would be most unlucky; worn or carried upon the person, it serves as a powerful protector. We once purchased a medicine-bag from a Fox Indian. Its original owner was dead. It was kept in a small pouch of worsted, and consisted of the skin of a mole, carefully tied up and containing five different kinds of roots and barks. One of the most intelligent Indians in the tribe refused to look at the contents, assuring us that it would cause him bad luck, and was disrespect to the man whose protector it had formerly been. Among many Mohammedans we find amulets worn which consist of little pouches containing strips of parchment, on which are written passages from the Koran. This suggests certain practices of the Jews, both ancient and modern. One evening we had occasion to have a little Russian Jew boy try on some garments. Several of his young friends came with him. When he had removed his jacket and shirt, one of the boys eagerly called our attention to a queer little knitted garment worn over the undershirt. At its four corners hung bits of blue worsted twisted into a sort of tassel. The garment had little corner pockets into which these blue twists might be tucked. "Did you ever see that

FIG. 9.—TERRA-COTTA HEAD. Mexico.

kind that Abraham has on?" asked Sammie. "No," we replied; "what is it for?" Abraham himself replied that it was something he wore for luck and to help him, and that every morning when he said his prayers he kissed these blue cords. We found that most of the boys had these, though one said he had not, but his father wore a large one which he let him kiss every day. Sammie told us that he had a different kind which he wore on his arm and on his forehead; that it was made of leather. He volunteered to show us one, which he did a few days later. Before he put this on for us he washed his hands and face and brushed his hair. He also fasted until he took it off, as he said he never wore it except before breakfast. Whatever the fringes of the garments and phylacteries may have been once, they are now, with these children and the more ignorant of the adult Jews, nothing more nor less than charms. It will here be of interest to quote some references to these things. In Numbers, xv, 38–41: "And the Lord spake unto Moses, saying: Speak unto the children of Israel, and bid them that they make them fringes [tassels in the corners] in the borders of their garments throughout their generations, and that they put upon the fringes of each border a cord of blue: and it shall be unto you for a fringe, that ye may look upon it, and remember all the commandments of the Lord, and do them. . . . That ye may remember, and do all my commandments, and be holy unto your God. I am the Lord your God, which brought you up out of the land of Egypt, to be your God."

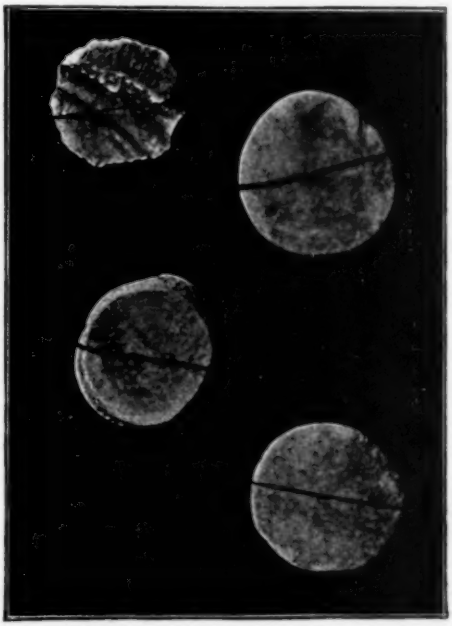


FIG. 10.—DISKS CUT FROM HUMAN SKULL, USED AS CHARMS. Illinois Mound.

As to the phylacteries, there is no such explicit direction as to their making. The details were, however, very exactly arranged by the religious teachers. The leathern boxes could be only made of cowskin; the thongs must be applied to the left arm and forehead in a particular way. The little box contains four passages of Scripture—Exod. xiii. 2–10, 11–14; Deut. vi, 4–9, 13–22—written on rolled strips of parchment. The ink used must be of a particu-

lar kind. The purpose was to remind the Israelites of the "bringing up out of the land of Egypt." The passages refer to that event and also to the command, which forms the excuse for the phylactery itself: "And these words which I command thee this day shall be in thine heart: . . . And thou shalt bind them for a sign upon thine hand, and they shall be as frontlets between thine eyes."

We shall close this rather rambling lecture with some suggestions relative to the religious meaning of mutilations, some of which were described in our first lecture, on deformations. We must first realize how savage and barbarous man looks upon blood. To begin with, he personally *loves* warm blood. He delights to drink it, to eat flesh reeking with it, to dip his hands into it, to splash his face and body with it. He has also some curious notions regarding it. A Brazilian bathes his infant in his enemy's blood, in order that the child may grow up a brave warrior. In Oceania the warrior dips his lance-tip into the blood of his slain foe to render himself invincible. In New Zealand the body of the dead foe was eaten in order that his blood might render the victor the heir of his bravery. Now, when savage and barbarous man, with his love for and his notions regarding blood, comes to think of higher beings, invisible but potent, whom he wishes to ally to himself, how can he better gain their friendship than by offering to them blood? And the *best* sacrifice is his own blood. Here we have the fundamental idea of every blood covenant. There are of course in any one instance other ideas present. But whatever these various significant features may be, in all we see a man trying to establish an artificial relationship with a deity by the shedding of his own blood. The people of any one clan or family worshiping the same god, the peculiar mode of shedding blood prevalent among them might become a tribal mark or sign. In Jewish circumcision — not originally Hebraic, but Egyptian—we see a good illustration of a blood covenant giving rise to a characteristic tribal mutilation. We see, too, in it very clearly a substitute for human sacrifice (see Exod. iv, 24). In Gen. xvii, 7, 10, 11, 17, 23: "And I will establish my covenant between me

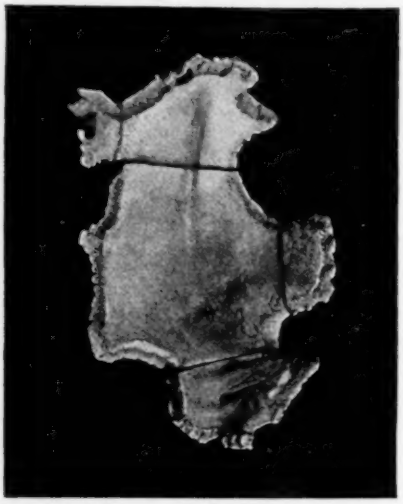


FIG. 11.—PORTION OF HUMAN SKULL FROM WHICH CHARMS HAVE BEEN CUT. Illinois Mound.

and thee, and thy seed after thee, in their generations, for an everlasting covenant; to be a God unto thee, and to thy seed after thee. . . . This is my covenant: . . . Every male child among you shall be circumcised; . . . and ye shall circumcise the flesh of your foreskin; and it shall be a token of the covenant betwixt me and you. . . . And Abraham took Ishmael his son, and all that were born in his house, and all that were bought with his money, every male among the men of Abraham's house; and circumcised the flesh of their foreskin, in the self-same day, as God had said unto him." We have no time, nor is it pertinent here, to consider all that circumcision has to teach, nor to trace its wide-spread practice in varying forms. Enough to say that everywhere we find underlying it the idea of sacrifice of one's own blood as a symbol of compact with some deity, more or less clearly. The Jew and the Egyptian circumcised, but many peoples do not do so. Such may, however, have some other bodily mutilation; for instance, a perforation as the sign of a blood covenant. Wherever the part of the body operated upon was visible to every passer, and the operation itself was a perforation, it might be that some object might be inserted in the opening to keep it open and to render it conspicuous. In such a way may have arisen the use of labrets and earrings. These plugs, at first rude, may become beautiful. When this occurs, the original religious idea may be lost sight of, and the perforation may still be made simply to admit of ornaments being worn.

FIG. 12.—CEREMONIAL STONE ADZE WITH CARVED HANDLE. South Seas.

The history of the ear perforation is particularly interesting. In its origin this is no doubt as truly a sign of a blood covenant as is the Jewish circumcision. It seems possible that the ancestors of the Jews were in compact with a god whose sign of covenant was ear-piercing. After this god was renounced and Jehovah

accepted, ear piercing among them was heathenism. Whether this is so or not, it is certain that the descendants of Ishmael were in covenant with such a god.

Judges, viii, 24, 25: "And Gideon said unto them, I would desire a request of you, that you should give me every man the ear-rings of his prey. For they had golden ear-rings, *because* they were Ishmaelites. And they answered, We will willingly give them. And they spread a garment, and did cast therein every man the ear-rings of his prey." And the suggestion of the same thing is very strong in Genesis, xxxv, 4: "And they gave unto Jacob all the strange gods which were in their hand, and all their ear-rings which were in their ears; and Jacob hid them under the oak which was by Shechem."

This sign of covenant with some other god than Jehovah crept at an early day, like so many other customs of heathenism, into the Christian Church. It has gradually disappeared. Lippert says that in the early Church it was customary to have the ears pierced, at the same time invoking the protection of saints against disease. Gradually this dwindled to invocation of a single saint's assistance against a single class of diseases—those of the eye. A remnant of this still lingers among those people who, in our own day and land, claim that they pierce their ears to help their eyesight. Such persons present us the last picture in a series the first of which is a savage man, whose ears are pierced merely to shed blood for the gratification of a deity whose aid he desires to secure.

We have thus considered a large number of curious and interesting points regarding dress and adornment. We have seen how the curious deformations so widely practiced have arisen, and how they are useful. We have queried as to the motives which have led to dress development and its results. We have emphasized the influence that the desire for adornment has exercised upon man's progress. We have lastly shown how a large number of articles of dress and ornament have come to have a religious significance, and how many other deformations have begun in connection with acts of worship.

THE remains of an extinct species of swan are described by Mr. H. O. Forbes, Director of the Canterbury Museum, New Zealand, as having been found in a newly discovered cave near Christchurch. Moa bones, with Maori relics—including implements, carvings, a lock of hair carefully done up, and other hair—were found so associated as to "show incontestably" that the Maori and moa were contemporaneous. Remains of various animals and other birds than the moa, which had been used for food, were found, but no human bones. Some of the birds appear to have been of species now extinct in New Zealand, and not elsewhere described.

SOME OF THE POSSIBILITIES OF ECONOMIC BOTANY.*

By GEORGE LINCOLN GOODALE.

[*Concluded.*]

III. Fruits. — Botanically speaking, the cereal grains of which we have spoken are true fruits, that is to say, are ripened ovaries, but for all practical purposes they may be regarded as seeds. The fruits, of which mention is now to be made, are those commonly spoken of in our markets as fruits.

First of all, attention must be called to the extraordinary changes in the commercial relations of fruits by two direct causes:

(1) The canning industry, and—

(2) Swift transportation by steamers and railroads.

The effects of these two agencies are too well known to require more than this passing mention. By them the fruits of the best fruit-growing countries are carried to distant lands in quantities which surprise all who see the statistics for the first time. The ratio of increase is very startling. Take, for instance, the figures given by Mr. Morris at the time of the great Colonial and Indian Exhibition in London. Compare double decades of years:

1845, £886,888.
1865, £3,185,984.
1885, £7,587,523

In the Colonial Exhibition at London, in 1886, fruits from the remote colonies were exhibited under conditions which proved that, before long, it may be possible to place such delicacies as the cherimoyer, the sweet-cup, sweet-sop, rambutan, mango, and mangosteen at even our most northern seaports. Furthermore, it seems to me likely that, with an increase in our knowledge with regard to the microbes which produce decay, we may be able to protect the delicate fruits from injury for any reasonable period. Methods which will supplement refrigeration are sure to come in the very near future, so that, even in a country so vast as our own, the most perishable fruits will be transported through its length and breadth without harm.

The canning industry and swift transportation are likely to diminish zeal in searching for new fruits, since, as we have seen in the case of the cereals, we are prone to move in lines of least resistance and leave well enough alone.

To what extent are our present fruits likely to be improved? Even those who have watched the improvement in the quality of

* Presidential address delivered before the American Association for the Advancement of Science, at Washington, August, 1891.

some of our fruits, like oranges, can hardly realize how great has been the improvement within historic times in the character of certain pears, apples, and so on.

The term historic is used advisedly, for there are prehistoric fruits which might serve as a point of departure in the consideration of the question. In the ruins of the lake-dwellings in Switzerland * charred apples have been found, which are, in some cases, plainly of small size, hardly equaling ordinary crab-apples. But, as Dr. Sturtevant has shown, in certain directions there has been no marked change of type; the change is in quality.

In comparing the earlier descriptions of fruits with modern accounts it is well to remember that the high standards by which fruits are now judged are of recent establishment. Fruits which would once have been esteemed excellent would to-day be passed by as unworthy of regard.

It seems probable that the list of seedless fruits will be materially lengthened, provided our experimental horticulturists make use of the material at their command. The common fruits which have very few or no seeds are the banana, pineapple, and certain oranges. Others mentioned by Mr. Darwin as well known are the bread-fruit, pomegranate, azarole or Neapolitan medlar, and date palms. In commenting upon these fruits, Mr. Darwin † says that most horticulturists "look at the great size and anomalous development of the fruit as the cause and sterility as the result," but he holds the opposite view as more probable—that is, that the sterility, coming about gradually, leaves free for other growth the abundant supply of building material which the forming seed would otherwise have. He admits, however, that "there is an antagonism between the two forms of reproduction, by seeds and by buds, when either is carried to an extreme degree, which is independent of any incipient sterility."

Most plant-hybrids are relatively infertile, but by no means wholly sterile. With this sterility there is generally augmented vegetative vigor, as shown by Nägeli. Partial or complete sterility and corresponding luxuriance of root, stem, leaves, and flower may come about in other obscure ways, and such cases are familiar to botanists.‡ Now, it seems highly probable that, either by hybridizing directed to this special end, or by careful selection of

* Carbonized apples have been found at Wangen, sometimes whole, sometimes cut in two, or, more rarely, into four pieces and evidently dried and put aside for winter use. . . . . They are small and generally resemble those which still grow wild in the Swiss forests; at Robenhausen, however, specimens have occurred which are of larger size, and probably cultivated. No trace of the vine, the walnut, the cherry, or the damson has yet been met with, but stones of the wild plum and the *Prunus padus* have been found." Lubbock, *loc. cit.*, p. 217.

† Animals and Plants under Domestication (American edition), vol. ii, p. 205–209.

‡ Gray's Botanical Text Book, vols. i and ii.

forms indicating this tendency to the correlated changes, we may succeed in obtaining important additions to our seedless or nearly seedless plants. Whether the ultimate profit would be large enough to pay for the time and labor involved is a question which we need not enter into; there appears to me no reasonable doubt that such efforts would be successful. There is no reason in the nature of things why we should not have strawberries without the so-called seeds; blackberries and raspberries, with only delicious pulp; and large grapes as free from seeds as the small ones which we call "currants," but which are really grapes from Corinth.

These and the coreless apples and pears of the future, the stoneless cherries and plums, like the common fruits before mentioned, must be propagated by bud division, and be open to the tendency to diminished strength said to be the consequence of continued bud-propagation. But this bridge need not be crossed until we come to it. Bananas have been perpetuated in this way for many centuries, and pineapples since the discovery of America, so that the borrowed trouble alluded to is not threatening. First we must catch our seedless fruits.

Which of our wild fruits are promising subjects for selection and cultivation?

Mr. Crozier, of Michigan, has pointed out* the direction in which this research may prove most profitable. He enumerates many of our small fruits and nuts which can be improved.

Another of our most careful and successful horticulturists believes that the common blueberry and its allies are very suitable for this purpose and offer good material for experimenting. The sugar-plum, or so-called shadbush, has been improved in many particulars, and others can be added to this list.

But again we turn very naturally to Japan, the country from which our gardens have received many treasures. Referring once more to Prof. Georgeson's studies,† we must mention the varieties of Japanese apples, pears, peaches, plums, cherries, and persimmons. The persimmons are already well known in some parts of our country under the name "kaki," and they will doubtless make rapid progress in popular favor.

The following are less familar: *Actinidia arguta* and *volubilis*, with delicious berries;

Stauntonia, an evergreen vine yielding a palatable fruit;

Myrica rubra, a small tree with an acidulous, juicy fruit;

Elæagnus umbellata, with berries for preserves.

The active and discriminating horticultural journals in America and Europe are alive to the possibilities of new Japanese fruits,

* American Garden, New York. 1890–'91. † Ibid. 1891.

and it can not be very long before our list is considerably increased.

It is absolutely necessary to recollect that in most cases variations are slight. Dr. Masters and Mr. Darwin have called attention to this and have adduced many illustrations, all of which show the necessity of extreme patience and caution. The general student curious in such matters can have hardly any task more instructive than the detection of the variations in such common plants as the blueberry, the wild cherry, or the like. It is an excellent preparation for a practical study of the variations in our wild fruits suitable for selection.

It was held by the late Dr. Gray that the variations in Nature by which species have been evolved were led along useful lines—a view which Mr. Darwin regretted he could not entertain. However this may be, all acknowledge that by the hand of the cultivator variations can be led along useful lines; and, furthermore, the hand which selects must uphold them in their unequal strife. In other words, it is one thing to select a variety and another to assist it in maintaining its hold upon existence. Without the constant help of the cultivator who selects the useful variety, there comes a reversion to the ordinary specific type which is fitted to cope with its surroundings.

I think you can agree with me that the prospect for new fruits and for improvements in our established favorites is fairly good.

IV. Timbers and Cabinet Woods.—Can we look for new timbers and cabinet woods? Comparatively few of those in common use are of recent introduction. Attempts have been made to bring into great prominence some of the excellent trees of India and Australia which furnish wood of much beauty and timber of the best quality. A large proportion of all the timbers of the South Seas are characterized by remarkable firmness of texture and high specific gravity.* The same is noticed in many of the woods of the Indies. A few of the heavier and denser sorts, like jarrah, of West Australia, and sabicu, of the Caribbean Islands, have met with deserved favor in England, but the cost of transportation militates against them. It is a fair question whether in certain parts of our country these trees and others which can be utilized for veneers may not be cultivated to advantage. Attention should be again called to the fact that many plants succeed far better in localities which are remote from their origin, but where they find conditions substantially like those which they have left. This fact, to which we must again refer in detail with regard to certain other classes of plants, may have some bear-

* Useful Native Plants of Australia. By J. H. Maiden, Sydney.

ing upon the introduction of new timber trees. Certain drawbacks exist with regard to the timber of some of the more rapidly growing hard-wood trees which have prevented their taking a high place in the scale of values in mechanical engineering.

One of the most useful soft-wooded trees in the world is the kauri. It is restricted in its range to a comparatively small area in the North Island of New Zealand. It is now being cut down with a recklessness which is as prodigal and shameful as that which has marked our own treatment of forests here. It should be said, however, that this destruction is under protest; in spite of which it would seem to be a question of only a few years when the great kauri groves of New Zealand will be a thing of the past. Our energetic Forest Department has on its hands problems just like this which perplexes one of the new lands of the South. The task in both cases is double: to preserve the old treasures and to bring in new.

The energy shown by Baron von Mueller, the renowned Government Botanist of Victoria, and by various forest departments in encouraging the cultivation of timber trees will assuredly meet with success; one can hardly hope that this success will appear fully demonstrated in the lifetime of those now living, but I can not think that many years will pass before the promoters of such enterprises may take fresh courage.

In a modest structure in the city of Sydney, New South Wales, Mr. Maiden* has brought together, under great difficulties, a large collection of the useful products of the vegetable kingdom as represented in Australia. It is impossible to look at the collection of woods in that museum, or at the similar and more showy one in Kew, without believing that the field of forest culture must receive rich material from the southern hemisphere.

Before leaving this part of our subject it may be well to take some illustrations in passing, to show how important is the influence exerted upon the utilization of vegetable products by causes which may at first strike one as being rather remote.

1. Photography makes use of the effect of light on chromatized gelatin to produce under a negative the basis of relief plates for engraving. The degree of excellence reached in modifications of this simple device has distinctly threatened the very existence of wood-engraving, and hence follows a diminished degree of interest in box-wood and its substitutes.

2. Iron, and in its turn steel, is used in ship-building, and this renders of greatly diminished interest all questions which concern the choice of the different oaks and similar woods.

3. But, on the other hand, there is increased activity in certain

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* Useful Native Plants of Australia. By J. H. Maiden, Sydney.

directions, best illustrated by the extraordinary development of the chemical methods for manufacturing wood-pulp. By the improved processes, strong fibers suitable for fine felting on the screen and fit for the best grades of certain lines of paper are given to us from rather inferior sorts of wood. He would be a rash prophet who should venture to predict what will be the future of this wonderful industry, but it is plain that the time is not far distant when acres now worthless may be covered by trees under cultivation growing for the pulp-maker.

There is no department of economic botany more promising in immediate results than that of arboriculture.

V. VEGETABLE FIBERS.—The vegetable fibers known to commerce are either plant-hairs, of which we take cotton as the type, or filaments of bast-tissue, represented by flax. No new plant-hairs have been suggested which can compete in any way for spinning with those yielded by the species of *Gossypium*, or cotton, but experiments more or less systematic and thorough are being carried on with regard to the improvement of the varieties of the species. Plant-hairs for the stuffing of cushions and pillows need not be referred to in connection with this subject.

Countless sorts of plants have been suggested as sources of good bast-fibers for spinning and for cordage, and many of these make capital substitutes for those already in the factories. But the questions of cheapness of production, and of subsequent preparation for use, have thus far militated against success. There may be much difference between the profits promised by a laboratory experiment and those resulting from the same process conducted on a commercial scale. The existence of such differences has been the rock on which many enterprises seeking to introduce new fibers have been wrecked.

In dismissing this portion of our subject it may be said that a process for separating fine fibers from undesirable structural elements, and from resin-like substances which accompany them, is a great desideratum. If this were supplied, many new species would assume great prominence at once.

VI. TANNING MATERIALS.—What new tanning materials can be confidently sought for? In his Useful Native Plants of Australia, Mr. Maiden * describes over thirty species of "wattles" or *Acacias*, and about half as many *Eucalypts*, which have been examined for the amount of tanning material contained in the bark. In all, eighty-seven Australian species have been under examination. Besides this, much has been done looking in the same direction at the suggestion and under the direction of Baron von Mueller, of Victoria. This serves to indicate how great is the

* Useful Native Plants of Australia. By C. H. Maiden, Sydney.

interest in this subject, and how wide is the field in our own country for the introduction of new tanning plants.

It seems highly probable, however, that artificial tanning substances will at no distant day replace the crude matters now employed.

VII. RESINS, ETC.—Resins, oils, gums, and medicines from the vegetable kingdom would next engage our attention if they did not seem rather too technical for this occasion, and to possess an interest on the whole somewhat too limited. But an allied substance may serve to represent this class of products and indicate the drift of present research.

*India Rubber.**—Under this term are included numerous substances which possess a physical and chemical resemblance to each other. An Indian *Ficus*, the early source of supply, soon became inadequate to furnish the quantity used in the arts even when the manipulation of rubber was almost unknown. Later, supplies came from *Hevea* of Brazil, generally known as Para rubber, and from *Castilloa*, sometimes called Central American rubber, and from *Manihot Glaziovii*, Ceara rubber. Not only are these plants now successfully cultivated in experimental gardens in the tropics, but many other rubber-yielding species have been added to the list. The *Landolphias* are among the most promising of the whole: these are the African rubbers. Now, in addition to these, which are the chief source of supply, we have *Willughbeia*, from the Malayan Peninsula, *Leuconotis*, *Chilocarpus*, *Alstonia*, *Forsteronia*, and a species of a genus formerly known as *Urostigma*, but now united with *Ficus*. These names, which have little significance as they are here pronounced in passing, are given now merely to impress upon our minds the fact that the sources of a single commercial article may be exceedingly diverse. Under these circumstances search is being made not only for the best varieties of these species but for new species as well.

There are few excursions in the tropics which possess greater interest to a botanist who cares for the industrial aspects of plants than the walks through the garden at Buitenzorg in Java and at Singapore. At both these stations the experimental gardens lie at some distance from the great gardens which the tourist is expected to visit, but the exertion well repays him for all discomfort. Under the almost vertical rays of the sun are here gathered the rubber-yielding plants from different countries, all growing under conditions favorable for decisions as to their relative value. At Buitenzorg a well-equipped laboratory stands ready to answer practical questions as to quality and composition of their products, and year by year the search extends.

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* See note (*), p. 71.

I mention this not as an isolated example of what is being accomplished in commercial botany, but as a fair illustration of the thoroughness with which the problems are being attacked. It should be further stated that at the garden in question assiduous students of the subject are eagerly welcomed and are provided with all needed appliances for carrying on technical, chemical, and pharmaceutical investigations. Therefore I am justified in saying that there is every reason for believing that in the very near future new sources of our most important products will be opened up, and new areas placed under successful cultivation.

At this point attention must be called to a very modest and convenient hand-book on the Commercial Botany of the Nineteenth Century, by Mr. Jackson, of the Botanical Museum attached to the Royal Gardens, Kew, which not only embodies a great amount of well-arranged information relative to the new useful plants, but is, at the same time, a record of the existing state of things in all these departments of activity.

VIII. FRAGRANT PLANTS.—Another illustration of our subject might be drawn from a class of plants which repays close study from a biological point of view, namely, those which yield perfumes.

In speaking of the future of our fragrant plants we must distinguish between those of commercial value and those of purely horticultural interest. The former will be less and less cultivated in proportion as synthetic chemistry by its manufacture of perfumes replaces the natural by the artificial products, for example, coumarin, vanillin, nerolin, heliotropin, and even oil of wintergreen.

But do not understand me as intimating that chemistry can ever furnish substitutes for living fragrant plants. Our gardens will always be sweetened by them, and the possibilities in this direction will continue to extend both by contributions from abroad and by improvement in our present cultivated varieties. Among the foreign acquisitions are the fragrant species of *Andropogon*. Who would suspect that the tropical relatives of our sand-loving grasses are of high commercial value as sources of perfumery oils?

The utility to the plant of fragrance in the flower, and the relation of this to cross-fertilization, are apparent to even a casual observer. But the fragrance of an aromatic leaf does not always give us the reason for its being.

It has been suggested for certain cases that the volatile oils escaping from the plants in question may, by absorption, exert a direct influence in mitigating the fierceness of action of the sun's rays. Other explanations have also been made, some of which are even more fanciful than the last.

When, however, one has seen that the aromatic plants of Australia are almost free from attacks of insects and fungi, and has learned to look on the impregnating substances in some cases as protective against predatory insects and small foes of all kinds, and in others as fungicidal, he is tempted to ask whether all the substances of marked odor which we find in certain groups of plants may not play a similar *rôle.*

It is a fact of great interest to the surgeon that in many plants there is associated with the fragrant principle a marked antiseptic or fungicidal quality; conspicuous examples of this are afforded by species of *eucalyptus,* yielding eucalyptol; *Styrax,* yielding styrone; *Thymus,* yielding thymol. It is interesting to note, too, that some of these most modern antiseptics were important constituents in the balsamic vulneraries of the earliest surgery.

Florists' plants and the floral fashions of the future constitute an engaging subject which we can touch only lightly. It is reasonably clear that while the old favorite species will hold their ground in the guise of improved varieties, the new introductions will come in the shape of plants with flowering branches which retain their blossoms for a somewhat long period, and especially those in which the flowers precede the leaves. In short, the next real fashion in our gardens is probably to be the flowering shrub and flowering tree, like those which are such favorites in the country from which the Western world has gladly taken the gift of the chrysanthemum.

Twice each year, of late, a reception has been held by the Emperor and Empress of Japan. The receptions are in autumn and in the spring. That in the autumn, popularly known as the Emperor's reception, has for its floral decorations the myriad forms of the national flower, the chrysanthemum; that which is given in spring, the Empress's reception, comes when the cherry blossoms are at their best. One has little idea of the wealth of beauty in masses of flowering shrubs and trees until he has seen the floral displays in the Imperial Gardens and the Temple grounds in Tokio.

To Japan* and China also we are indebted for many of the choicest plants of our gardens, but the supply of species is by no means exhausted. By far the larger number of the desirable plants have already found their way into the hands of cultivators, but often under conditions which have restricted their dissemination through the flower-loving community. There are many which ought to be widely known, especially the fascinating dwarf

* The Flowers of Japan and the Art of Floral Arrangement. By Josiah Conder, F. R. I. B. A., Architect to the Imperial Japanese Government. Yokohama, 1891. See also two other works by the same author: Theory of Japanese Flower Arrangements, and Art of Landscape Gardening in Japan. (1886.)

shrubs and dwarf trees of the far East, which are sure to find sooner or later a warm welcome among us.

X. FORAGE PLANTS.—Next to the food-plants for man, there is no single class of commercial plants of greater interest than the food-plants for flocks and herds. Forage plants, wild and cultivated, are among the most important and highly valued resources of vast areas. No single question is of more vital consequence to our farthest West and Southwest.

It so happens that the plants on which the pastoralist relies grow or are grown on soil of inferior value to the agriculturist. Even soil which is almost sterile may possess vegetation on which flocks and herds may graze; and, further, these animals may thrive in districts where the vegetation appears at first sight too scanty or too forbidding even to support life. There are immense districts in parts of the Australian continent where flocks are kept on plants so dry and desert-like that an inexperienced person would pass them by as not fit for his sheep, and yet, as Mr. Samuel Dixon* has well shown, these plants are of high nutritive value and are attractive to flocks.

Relegating to the notes to be published with this address brief descriptions of a few of the fodder-plants suggested for use in dry districts, I shall now mention the salt-bushes of various sorts, and the allied desert plants of Australia, as worth a careful trial on some of our very dry regions in the farthest West. There are numerous other excellent fodder-plants adapted to dry but not parched areas which can be brought in from the corresponding districts of the southern hemisphere and from the East.

At an earlier stage of this address I have had occasion to refer to Baron von Mueller, whose efforts looking toward the intro-

* Mr. Samuel Dixon's list is in vol. viii (for 1884–'85) of the Transactions and Proceedings and Report of the Royal Society of South Australia. Adelaide, G. Robertson, 1886. *Bursaria spinosa:* "A good stand-by," after the grasses dry up. *Pomaderris racemosa*, "stands stocking well." *Pittosporum phyllaeroides:* "Sheep exceedingly partial to its foliage." *Casuarina quadrivalvis:* "Tenderness of fiber of wool would be prevented by it in our finer wool districts." *Acacias*, the wattles: "Value as an astringent, very great," being curative of a malady often caused by eating frozen grass. *Acacia aneura* (mulga): "Must be very nutritious to all animals eating it." This is the plant which is such a terror to the stockmen who have to ride through the "scrub." *Cassia*, some of the species with good pods and leaves for sheep. The foregoing are found in districts which are not wholly arid. The following are, more properly, "dry" plants. *Sida petrophila:* "As much liked by sheep as by marsupials." *Dodonæa viscosa*, native hop-bush: "Likes warm, red, sandy ground." *Lycium australe:* "Drought never seems to affect it." *Kochia aphylla:* "All kinds of stock are often largely dependent on it during protracted droughts." *Rhagodia parabolica:* "Produces a good deal of foliage." *Atriplex vesicaria:* "Can be readily grown wherever the climate is not too wet." I have transferred only those which Mr. Dixon thinks most worthy of trial. Compare also Dr. Vasey's valuable studies of the plants of our dry lands, especially grasses and forage plants (1878), grasses of the arid districts of Kansas, Nebraska, and Colorado (1886), grasses of the South (1887).

duction of useful plants into Australasia have been aided largely by his convenient treatise on economic plants.* It may be said in connection with the fodder-plants, especially, that much which the baron has written can be applied *mutatis mutandis* to parts of our own country.

The important subject of introducing fodder-plants has been purposely reserved to the last because it permits us to examine a practical point of great interest. This is the caution which it is thought necessary to exercise when a species is transferred by our own choice from one country to another. I say by our choice, for, whether we wish it or not, certain plants will introduce themselves. In these days of frequent and intimate intercommunication between different countries, the exclusion of foreign plants is simply impossible. Our common weeds are striking illustrations of the readiness with which plants of one country make for themselves a home in another.† All but two of the prominent weeds of the Eastern States are foreign intruders.

There are all grades of persistence in these immigrants. Near the ballast grounds of every harbor, or the fields close by woolen and paper mills where foreign stock is used, you will observe many foreign plants which have been introduced by seed. For many of these you will search in vain a second year. A few others persist for a year or two longer, but with uncertain tenure of the land which they have invaded; others still have come to stay. But happily some of the intruders, which seem at first to gain a firm foothold, lose their ground after a while. We have a conspicuous example of this in a hawkweed, which was very threatening in New England two years ago, but is now relaxing its hold.

Another illustration is afforded by a water-plant which we have given to the Old World. This plant, called in our botanies *Anacharis*, or *Elodea*, is, so far as I am aware, not troublesome in our ponds and water-ways, but when it was carried to England, perhaps as a plant for the aquarium, it was thrown into streams and rivers with a free hand. It spread with remarkable rapidity and became such an unmitigated nuisance that it was called a curse. Efforts to extirpate it merely increased its rate of growth. Its days of mischief are, however, nearly over, or seem to be drawing to a close; at least so Mr. Lynch, of the Botanic Garden in Cambridge, England, and others of my informants think. The history of the plant shows that even under conditions which, so

* See note, p. 59.

† The weeds of German gardens and agricultural lands are mostly from Mediterranean regions, but the invasions in the uncultivated districts are chiefly from America (such as *Œnothera*, *Mimulus*, *Rudbeckia*). *Handbuch der Pflanzengeographie*, von Dr. Oscar Drude (Stuttgart), 1890, p. 97.

far as we can see, are identical with those under which the plant grew in its home, it may for a time take a fresh lease of life and thrive with an undreamed-of energy.

What did *Anacharis* find in the waters of England and the Continent that it did not have at home, and why should its energy begin to wane now?

In Australasia one of the most striking of these intruders is sweet-brier. Introduced as a hedge plant, it has run over certain lands like a weed, and disputes every acre of some arable plats. From the facility with which it is propagated it is almost ineradicable. There is something astounding in the manner in which it gains and holds its ground. Gorse and brambles and thistles are troublesome in some localities, and they prove much less easy to control than in Europe. The effect produced on the mind of the colonist by these intruding pests is everywhere the same. Whenever, in an examination of the plants likely to be worthy of trial in our American dry lands, the subject was mentioned by me to Australians, I was always enjoined to be cautious as to what plants I might suggest for introduction from their country into our own. My good friends insisted that it was bad enough to have as pests the plants which come in without our planning or choice, and this caution seems to me one which should not be forgotten.

It would take us too far from our path to inquire what can be the possible reasons for such increase of vigor and fertility in plants which are transferred to a new home. We should have to examine all the suggestions which have been made, such as fresh soil, new skies, more efficient animal friends, or less destructive enemies. We should be obliged also to see whether the possible wearing out of the energy of some of these plants after a time might not be attributable to the decadence of vigor through uninterrupted bud-propagation, and we should have to allude to many other questions allied to these. But for this time fails.

Lack of time also renders it impossible to deal with the questions which attach themselves to our main question, especially as to the limits of effect which cultivation may produce. We can not touch the problem of inheritance of acquired peculiarities, or the manner in which cultivation predisposes the plant to innumerable modifications. Two of these modifications may be mentioned in passing, because they serve to exemplify the practical character of our subject.

Cultivation brings about in plants very curious morphological changes. For example, in the case of a well-known vegetable the number of metamorphosed type-leaves forming the ovary is two, and yet under cultivation the number increases irregularly until the full number of units in the type of the flower is reached.

Prof. Bailey, of Cornell, has called attention to some further interesting changes in the tomato, but the one mentioned suffices to illustrate the direction of variation which plants under cultivation are apt to take. Monstrosities are very apt to occur in cultivated plants, and under certain conditions may be perpetuated in succeeding generations, thus widening the field from which utilizable plants may be taken.

Another case of change produced by cultivation is likewise as yet wholly unexplained, although much studied, namely, the mutual interaction of scion and stock in grafting, budding, and the like. It is probable that a further investigation of this subject may yet throw light on new possibilities in plants.

We have now arrived at the most practical question of all, namely—

In what way can the range of commercial botany be extended? In what manner or by what means can the introduction of new species be hastened?

It is possible that some of you are unaware of the great amount of uncoördinated work which has been done and is now in hand in the direction of bringing in new plants.

The competition between the importers of new plants is so great both in the Old World and the New that a very large proportion of the species which would naturally commend themselves for the use of florists, for the adornment of greenhouses, or for commercial ends, have been at one time or another brought before the public or are being accumulated in stock. The same is true, although to a less extent, with regard to useful vegetables and fruit. Hardly one of those which we can suggest as desirable for trial has not already been investigated in Europe or this country, and reported on. The pages of our chemical, pharmaceutical, medical, horticultural, agricultural, and trade journals, especially those of high grade, contain a wealth of material of this character.*

But what is needed is this, that the promising plants should be systematically investigated under exhaustive conditions. It is not enough that an enthusiast here, or an amateur there, should give a plant a trial under imperfectly understood conditions, and then report success or failure. The work should be thorough and every question answered categorically, so that we might be placed in possession of all the facts relative to the object experimented upon. But such an undertaking requires the co-operation of many different agencies. I shall venture to mention some of these.

In the first place—botanic gardens amply endowed for re-

* The list of economic plants published by the department in Washington is remarkably full, and is in every way creditable to those in charge.

search. The Arnold Arboretum, the Shaw Garden, and the Washington Experimental Garden are American illustrations of what is needed for this purpose. University gardens have their place in instruction, but can not wisely undertake this kind of work.

In the second place—museums and laboratories of economic botany. Much good work in this direction has been done in this country by the National Museum and by the department in charge of the investigation of new plants. We need institutions like those at Kew in England, and at Buitenzorg in Java, which keep in close touch with all the world. The founding of an establishment on a scale of magnitude commensurate with the greatness and needs of our country is an undertaking which waits for some one of our wealthy men.

In the third place—experiment stations. These may, within the proper limits of their sphere of action, extend the study of plants beyond the established varieties to the species, and beyond the species to equivalent species in other genera. It is a matter of regret that so much of the energy displayed in these stations in this country, and we may say abroad, has not been more economically directed.

Great economy of energy must result from the recent change by which co-ordination of action is assured. The influence which the stations must exert on the welfare of our country and the development of its resources is incalculable.

In the last place, but by no means least, the co-operation of all who are interested in scientific matters, through their observation of isolated and associated phenomena connected with plants of supposed utility, and by the cultivation of such plants by private individuals, unconnected with any State, governmental, or academic institutions.

By these agencies, wisely directed and energetically employed, the domains of commercial and industrial botany will be enlarged. To some of the possible results in these domains I have endeavored to call your attention.

THE stock of diamonds, according to the calculations of Iron, has increased enormously during the past fifteen years. The product of the African mines, 1,500,000 carats in 1876, was 4,000,000 carats in 1889. Still, the demand for diamonds increases, and the price rises every year. The traffic in diamonds is essentially different from all other trades in the single item that the product is never consumed. While there is a perceptible wear even in gold and silver, a diamond, once cut, is permanently added to the stock, and is liable to come upon the market at any time. Yet a place and eager purchasers are found for all the new ones.

THE LOST VOLCANOES OF CONNECTICUT.

By Prof. WILLIAM MORRIS DAVIS.

SEVERAL years ago, while walking down the lower Connecticut valley with a party of students, we chanced upon a curious ledge of rock surmounting a low ridge by the road that runs from Berlin to Meriden, about half-way between Hartford and New Haven. A scramble up the slope through a bushy growth of young trees led to the foot of the ledge—a thick bed of gray-greenish rock, not in layers like limestone or sandstone, not crystalline like granite or gneiss, but of a loose, structureless texture, here and there carrying roughly rounded blocks of a dense, dark rock which we knew to be an old lava, from its resemblance to the rocks ejected from modern volcanoes. Although a ledge of this kind is not of ordinary occurrence, its features were so well marked that there could be little doubt of its nature and origin; it was a bed of volcanic ashes, interspersed with blocks or bombs of lava that must have been thrown from some neighboring vent long ago in the ancient time when the rocks of the valley were made. The ash-bed lay upon a series of muddy sandstones that

Fig. 1.

had evidently been formed under water, for they were deposited in layers, just as sand and mud are now when they are washed into a pond; and to all appearances the eruption of the ashes and bombs had taken place during the accumulation of the sandstones. The ashes had fallen into the water and settled down gently on the soft, sandy mud at the bottom; one of the dense lava blocks was seen to have indented itself in the sandy layers, bending them down on either side of it, just as if it had been an early product of

the eruption, arriving here before the ashes, plunging down after its lofty flight through the air, and sinking into the mud at the bottom of the water. In this it recalls the reptilian footprints that have made the sandstones of the valley famous. The old reptiles walked over the mud-flats and left their heavy prints on the surface to be buried under the next layer of mud; the lava block fell into the soft sandy mud and made its print, where it still lies. Long may it rest undisturbed! A poor indication of it is presented in Fig. 1, copied from a photograph by a friend in New Britain, Conn. All this was much more evident and more easily interpreted than those who try to learn geology from books are disposed to believe. Indeed, one of the students with me exclaimed: "This is the most realistic thing I ever saw; I had no idea that it could be so plainly made out." The ledge has been visited by hundreds of persons from Meriden and the surrounding towns, and a well-beaten path now leads up to it from the road. I have taken parties of students there every summer since then, and hope to do my share toward beating down that path for many years to come. But although the meaning of the ash-bed is plain enough, there is a question suggested by it that is not so easily answered. Where is the volcano from which the ashes and bombs were blown out?

The same question has arisen in other countries. For example, in central France, in Auvergne, there are chalky beds that were once a soft white mud, and in these lie bombs of lava, bending down the layers on either side; manifestly again the result of a bombardment from some adjacent volcano. In the same district there are beds of ashes and flows of lava, all indicating volcanic outbursts in their vicinity; but when the question is there asked—Where are the volcanoes from which these products came?—it is easily answered, for many volcanic cones still stand up in plain sight near by; the lava-flows may be traced up to their bases, the craters are still visible at the summits, and although no record exists of their eruptions, it is manifest that at a relatively recent prehistoric period these cones exhibited a brisk activity. I walked over them a dozen years ago; they make a delightful strolling and sketching ground, and I remember well lunching with a shepherd on one of their sunny slopes, and answering his questions about distant America (Fig. 2).

We may look in vain for volcanic cones in the neighborhood of our Meriden ash-bed bluff. There are hills and ridges all around, but nowhere can we see the smooth and characteristic concave slopes of a volcanic cone. To the south, there are several symmetrically rounded hills, but they are convex, not concave, on the side, and an examination of the road-cuts made in their slopes shows them to be of anything but volcanic origin. They are "drumlins," hills

of rubbish that were left there and given their even form when the whole of New England was buried in a deep sheet of moving ice, as Greenland is now (Fig. 3). They give no clew to the source of the bombs and ashes. If we go west or east of the ash-bed ledge, there are high ridges, six or seven hundred feet above the valley, with gentle slopes on the east, and bold, rocky cliffs, descending to a long stony talus on the west. The one next east of us is Mount Lamentation; it may be well seen eastward from the railroad between Hartford and Meriden while the train is passing a pond. The ash-bed ledge can be seen at the same time under the southern end of Lamentation, but it is not a conspicuous object a mile away. Lamentation and its fellows are not the least like volcanoes, and yet they confirm the belief that volcanoes must have once existed hereabouts; for these high ridges are of lava, the edges of great tilted lava-flows that were poured out at intervals during the deposition of hundreds and thousands of feet of sandstones.

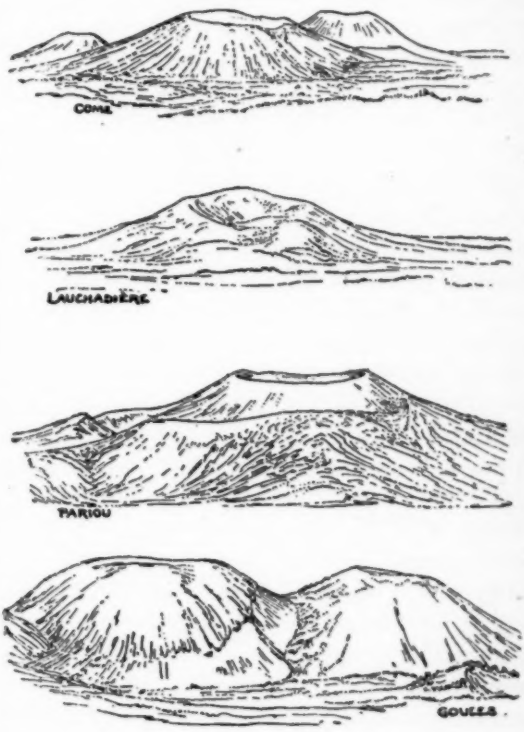


FIG. 2.

FIG. 3.

Our ash-bluff is indeed only a part of one of these parallel lava-ridges; when traced north and south lava may be found lying on the ash-bed. Lamentation is higher, because its lava-flow is much thicker than that in the ash-bed ridge, and therefore has not been worn down so low. On the back of these flows, at one point and another, may be seen the slaggy, bubbly surface of the lava, like that poured out of Vesuvius or any other modern volcano; but these ancient lavas have been deeply buried in

sands and muds, and tilted up and worn down, during the evolution of their present form. There is a quarry at Meriden where one lava-sheet may be seen lying directly upon the scoriaceous, ropy surface of an older one. Evidently, the region has witnessed volcanic action, as the ash-bed implied. Perhaps we fail to recognize the cone at the point of outburst because it has been partly worn away. There are many volcanic regions where the eruptive action is not so recent as in Auvergne, and where the cones are consequently somewhat out of repair; deep gulleys furrow their sides and destroy their symmetrical form. Something of this may, indeed, be seen in Auvergne, for the volcanoes there are not all of the same age. Some are sadly wasted, and are recognized as volcanoes only because their remnants of lava-flows and ash-beds all slope away from a central lava-mass, which marks the place of the vent. It is chiefly in this way that the Madeira Islands differ from the Azores; the latter possess many cones of regular form, but the older volcanoes on the former are deeply dissected; so much so that it is difficult to reconstruct the original cones from which the present rugged hills and ridges have been carved out. The same contrast may be seen on a grand scale in the Hawaiian Islands, as described by Dana. The most southeastern of the group is the most recent. It is the largest, and is in the best repair; not a volcanic cone of the usual steep-sided form, indeed, but of long, smooth, gentle slopes, because its lavas were too liquid when erupted to stand on steep slopes such as are formed by heaps of ashes and cinders. Other islands farther to the northwest in the same group are mere wrecks; their edges are cut off by the waves, forming great sea-cliffs, their slopes are scored by deep ravines and cañons, and their once even profiles are replaced now by sharply notched outlines. Yet nothing of even those angular forms is to be found about Meriden. If the absence of the cone from which the ashes came is due to wearing away, it must truly have been worn out.

There is, however, another method of disposing of volcanoes that has been practiced in Italy. The cone has either been blown to pieces and scattered by violent eruptions, or has been allowed to sink down by the withdrawal of lava from beneath its foundations. In either case, a great basin, often holding a lake, marks the site of the lost cone. There are several lakes of this kind in Italy—Trasimeno, Bolsena, Bracciano, and others; Sumatra possesses some huge basins of the same pattern; but there are no such basins in Connecticut. There are no lakes at all near Meriden, and the lakes in the back country are only old valleys obstructed by glacial drift.

There is an account of an old volcanic region out in New Mexico that may, perhaps, guide our search. In the district of the

Zuñi plateaus, Dutton describes numerous relatively small isolated buttes or sharply conical hills, steeper sided than volcanic cones, of a different profile, and without the crater at the top. They consist of dense lava, not in layers spread out from a central vent upon the surrounding surface, but in a solid mass with columnar structure; and at their bases it is sometimes possible to see that they are inclosed on all sides by the country rock. It is believed that these buttes are nothing more than lava-plugs, frozen solid in the pipes up through which the lava rose at the time of eruption from its deep source to the surface where it overflowed; but that the time of eruption is so long ago that the cones and all the surface outpourings are worn away, and only the stumps of the plugs remain to tell the tale. Fig. 6 attempts to show the early and late forms, one below the other. Structures of the same kind are known in the Black Hills, in Scotland, and elsewhere. Perhaps this hint will help us in understanding Connecticut.

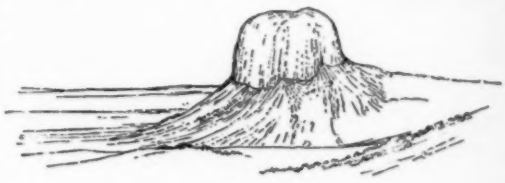


FIG. 4.

FIG. 5.

There is one thing about the ash-bed and lava-sheets in Connecticut that is certainly favorable to the suggestion given by the Zuñi buttes. The lava-sheets are not now level, as they undoubtedly were when they were poured out; but all the series of sandstones, ash-beds, lava-sheets, and the rest have been lifted up together on the western side of the valley, so that they slant down or dip to the eastward at a moderate angle. Standing on the bluff of the ash-bed, it is easy to trace its edge north and south, and to perceive that it is continued slanting underground on the east, and to imagine that it was once continued upward into the air on the west; for on this side the uplifting exposed it to the patient, persistent attack of the weather, by which in the course of ages it may have been greatly worn away. In the same way, other lava-ridges in the neighborhood, such as Mount Lamentation and the beautiful Hanging Hills, are simply the worn edges of lava-sheets that still plunge underground eastward, and that once rose high into the air westward.

It follows from this new understanding that if the vent, from which the ashes were blown and the lavas poured, lay to the east

of the ash-bed ridge, it must be still underground and not discoverable at present. It may be revealed to distant future ages, but to us it is buried. But if the vent lay to the west of the ridge, it may be discovered, not as the cone for which we looked at first, but as a pipe or neck of lava. Indeed, it must in this case be discoverable, for the lava and ashes must somewhere have risen from a deep subterranean reservoir, through the country rocks, up to the surface; and if their point of escape lie west of the ash-bed ridge, it must be in sight somewhere. We may not now hope to find the cone where the lavas rose and burst out through the body of water in which the muddy sandstones were accumulating; we can not now hope to discover the crater from which the ashes and bombs were scattered far and wide, and from whose flanks the lava-floods were poured over the low grounds around about it; but we may hope to find a knob or hill where the lava-pipe has been worn down to an undetermined depth beneath the surface on which its cone was built.

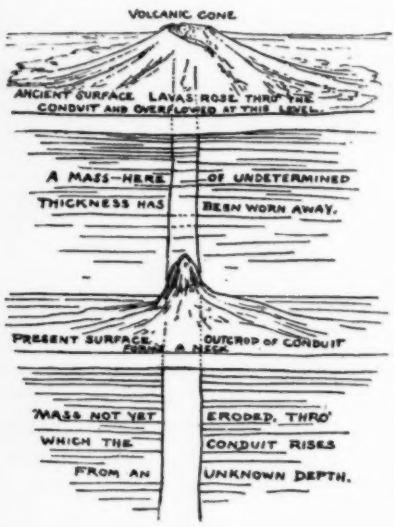


FIG. 6.

This seems to be the fact. Some ten miles southwest of Meriden lie the rugged Blue Hills, one of which is known as Mount Carmel. These may be seen to the west of Wallingford, on the railroad between New Haven and Hartford, or east of Mount Carmel station on the New Haven and Northampton Railroad. They consist of a network of thick necks and dikes of lava; not of loose texture like the ashes, not slaggy like the backs of the lava-sheets, but dense and solid, as if they had been driven there under great pressure. Mount Carmel and its fellows have not the simple outline of the Zuñi buttes; they are of irregular form, corresponding to their complicated structure, as if a compound fracture had been opened to give passage to the ascending lavas, or as if repeated eruptions had forced their way surfaceward at this point, every one increasing the size and complexity of the lava pipes and cracks. There is no other vent of the kind to be found so near to the ash-bed and lava ridges of the Meriden district as Mount Carmel; and while it is entirely possible that a vent may exist at a less distance on the east, concealed beneath the overlying strata in that direction, it is at least permissible

and plausible to regard Mount Carmel and the Blue Hills as the source of the ashes and bombs and lava-sheets over by Meriden and up and down the valley.

The Blue Hills have rough slopes to climb, but the view from their tops and the suggestion of past history that one gains there pay for the labor of the scramble. It is easily understood that the rocks are lavas and that they have ascended through the surrounding rocks from some deep source. It is manifest that they did not rise from below when the surface of the country had its present form, for in that case they must have flowed down into the low lands on all sides, and they must have had the slaggy and scoriaceous texture characteristic of surface lavas. One can not doubt that when the lavas of the Blue Hills were placed in their present relation to their surroundings they were deep underground, inclosed by rocky walls on all sides, and heavily pressed upon by the mass above. They forced their way upward from some deep reservoir of molten lava because the push upon them was even greater than the heavy resistance from above. They reached the surface at last, hundreds or thousands of feet above the present summit of the Blue Hills, and there burst out in true volcanic eruption, forming a conical island in the great estuary in which the valley sandstones were formed. We can hardly suppose that they built a grand cone, like Fujiyama, in Japan, twelve thousand feet above sea-level; perhaps they only formed a small mound, like the little temporary volcanic island that appeared in the middle Mediterranean in 1831, called Graham Island, Isle Julia, and Nerita, by its various discoverers. But the Blue Hills were undoubtedly in eruption more than once. This may be safely inferred from the complex network of their pipes and dikes, as well as from the repeated occurrence of lava flows among the series of bedded rocks in the Meriden district. In this respect, as in others, the Blue Hills were like volcanoes of our times. Some of their outpourings were more plentiful than others. Mount Lamentation is part of a lava-sheet whose thickness must be from three to four hundred feet, and whose total original area must have been at least two or three hundred square miles. But the other sheets are not so massive as this one; they indicate eruptions of less energy. While the eruptions were going on there must have been a great scurrying about of the old reptiles whose tracks are found on the sandstone beds at various points in the valley; perhaps the patient searcher may some day find one of their skeletons buried under the ashes of an eruption, just as the old Pompeians have been found buried under the mud and ashes from the outburst of Vesuvius that destroyed their city. During the intervals of rest between the eruptions a luxuriant growth of tree-ferns may have clothed the

slopes of the volcanic island, for leaves of cycads are found in the neighboring beds of shales. And yet all this is gone. The volcanoes are only things of the imagination. The Blue Hills mark the conduits through which they were fed with lavas, but the cones are lost in the empty air above; only the deep roots of the structure are now preserved for us.

Perhaps the accompanying diagrams may aid the reader in gaining a fuller understanding of the geological history of the region. They are drawn from a wooden model that was prepared for exhibition before the Geological Society of America at its last winter meeting in Washington. The first (Fig. 7) represents a block of the Triassic formation, lying horizontally on its deep crystalline foundation, the whole representing a cube of about ten miles on a side, and hence showing a hundred square miles of upper surface. The oblique lines across the top need not be considered for the present. The horizontal lines around the sides near the top are the interbedded lava-sheets, and all these, with the sandstones and shales, lie on the upturned eroded edges of the foundation of old crystalline rocks. The bedded rocks were spread out in the old sinking estuary in deposits of great volume, aggregating ten or twelve thousand feet in thickness at least, but always in shallow water, for they frequently show cross-bedding and ripple marks, and sometimes mud-cracks and rain-drops, and occasionally even foot-prints of various kinds. The famous Hitchcock collection, in the Amherst College Museum, illustrates all these features in great variety. During the period of accumulation of the bedded rocks there were at least three epochs of considerable volcanic activity. About half of the total thickness of the strata had been deposited when the first outburst took place, and this is the one that yielded the ashes and bombs at Meriden. Its lava-flows spread many miles north and south, but gained only a moderate measure of thickness, generally not more than a hundred feet. These correspond to the bed marked A in Fig. 8, which represents a magnified view of a corner of the block seen

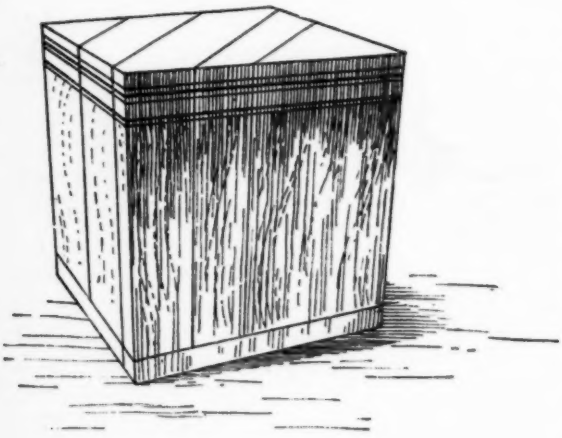


FIG. 7.

in Fig. 7. When this first volcanic disturbance was over, the accumulation of sandstones went on again, the sands were washed in from the shores of the estuary and crept out over the back of the lava-sheet; the finer sediments settled down into the irregular crevices in the surface of the flow, even filling little half-open vesicles. A microscopic examination of specimens from these contacts of lava and overlying sandstones brings back vividly the condition of their deposition. Loose fragments of the lava, carried a little way by the waves and more or less water-worn, were mixed with the sands for a few feet above the lava, but they were soon all buried. Then things went on for a long time about as before the eruption. The supply of sediments seems to have become finer after a while, for a bed of black shale is found, with numerous impressions of fossil fishes and plants, one of the few traceable fossiliferous layers of the entire formation. Then came more barren sandy shales again. It is impossible to measure the time of this quiet work in years, but after three or four hundred feet of strata had been formed, another outburst of lava (M) took place, and on a greater scale than the first. The lava-sheet formed by this eruption is three or four hundred feet thick—thick enough to have in all probability filled the shallow estuary wherever it ran, transforming it into a level lava plain, like the plain of the Shoshone River of to-day But the depression of the estuary trough continued; if the lava surface was at first above water level, it was soon submerged and buried in sands and mud, repeating all the significant phenomena of contact that have been mentioned above. Then came another long period of quiet, broken by a third lava outpouring (P); and after that, still more sandstones and shales, until aqueous and igneous rocks had accumulated to a thickness of perhaps two miles. At some time during this long history a sheet of lava was driven in or intruded between the sandstones near the bottom of the formation (marked I in Fig. 8);

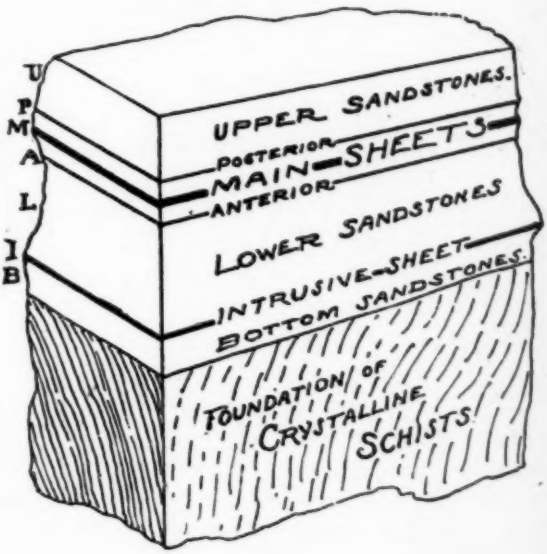


FIG. 8.

it is easily known to be an intrusion by the dense texture of its upper surface, and by the occasional branches that rise from it into the overlying beds, and by various other features in which it differs distinctly from the overflow sheets or extrusions. But it need not be further considered now.

In order to exhibit these relations of the igneous rocks to the stratified deposits in a clearer manner, the model is constructed so as to open on a diagonal section (as in Fig. 9), and disclose the

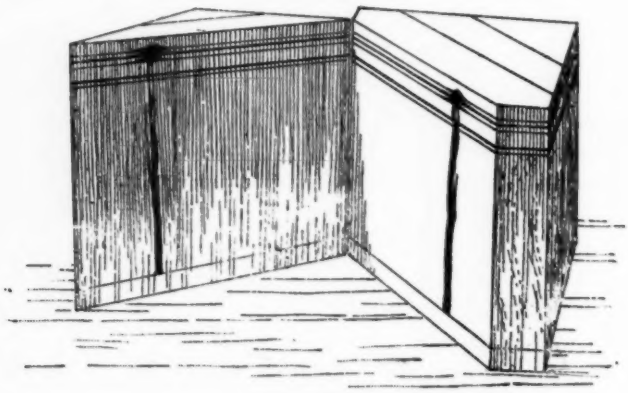


FIG. 9.

pipe or chimney up through which the lavas rose from their deep source. The volcanic cones, presumably formed at the surface where the chimney opened at the three times of eruption, are here placed in their proper positions in the series of stratified deposits; but even the topmost cone is supposed to have been entirely buried by gradual submergence and by the accumulation of sands and muds upon it. The intrusive sheet is shown near the bottom of the stratified series. The whole series may then be named as follows. First, a moderate thickness of bottom sandstones, often conglomeratic; then, the intrusive sheet; next, the great series of lower sandstones and shales, also sometimes conglomeratic; then, the three extrusive sheets, with their intervening sandstones and shales. The first of the extrusions will be called the anterior sheet, the middle one is the main sheet, the third is the postorior (for reasons that will appear more clearly further on), and they are separated by the anterior and posterior shales respectively. On the top of all come the upper sandstones and shales. The whole series is probably two miles thick, as already stated.

We may imagine in a general way that in time the estuary was filled with the detritus that was washed into it, and thus transformed into a lowland plain, like that of the Po, between the Alps and the Apennines; or like the plain of California, between the Sierra Nevada and the coast range. If it was not ultimately filled

up so as to form a land area, it was at least a subaqueous plain of very even and level surface. The deeper layers of the formation may have sagged a little toward the middle of the estuary on account of the progressive depression that the region had suffered during the accumulation of the entire mass, but their departure from horizontality was moderate. Yet at present the whole series, with but trifling exceptions, inclines at an angle of twelve, fifteen, or twenty degrees to the eastward. Evidently a serious disturbance has affected the original attitude of the beds.

The eastward slant or dip of the series might be imitated by tilting the model over bodily, so that its upper surface should be inclined to the east; but this fails to represent the dislocations by which the mass is known to be traversed. The model was therefore made in several parts, each of which could be tilted independently of its neighbors, as shown in Fig. 10, the observer looking southeast. It is here made clear that while the dip of the beds is to the eastward, the course of the fractures by which they are dislocated is northeastward; this relation prevailing in a very constant manner in the region of the Meriden ash-bed. The blocks into which the mass is thus divided, five of which are shown in the model, have been moved by moderate amounts on one another; the movement varies from a few feet up to two thousand. This is called faulting, and its effect in this case is manifestly to break up the continuous surface of the inclined plane that would have been formed by simple tilting, and produce a discontinuous surface, with steps from one part to another. If we may judge by the angle at which the beds lie, the elevated edges of these dislocated blocks must have once risen high into the air, producing mountainous ridges of no insignificant relief. Yet at present nothing of this ancient constructional form is apparent. The tilting and faulting were both done so long ago that no part of the original surface remains. It has all been worn away. The best evidence of the antiquity of the dislocations is found in another State.

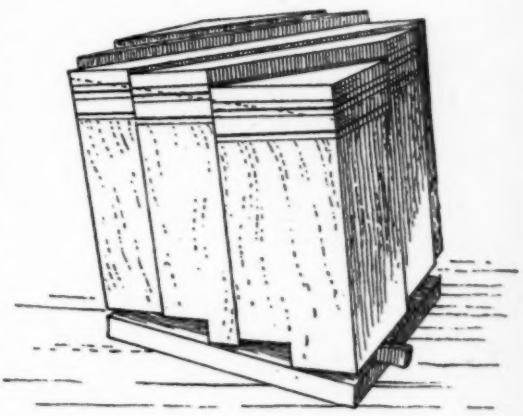


FIG. 10.

Down in New Jersey, the corresponding red sandstone forma-

tion is unconformably overlain by the Cretaceous strata of the coastal plain, proving that the sandstones were not only tilted but deeply eroded before the Cretaceous beds were laid upon them. The formations in New Jersey and Connecticut are so much alike that we may safely conclude that the period of dislocation was the same in both; hence we shall suppose that the Meriden sandstones and lava-sheets were tilted and faulted into the position illustrated in Fig. 10 during the interval between Triassic and Cretaceous time—that is, in the Jurassic period. From that time to now their history is concerned chiefly with the erosion by which their original constructional inclined planes have been reduced to their present surface of varied topography.

There is good reason to think that the history of the erosion is a double one, comprehending first a longer cycle, and second a shorter cycle of time. During the first cycle, the great relief of the uptilted beds was reduced to a lowland of denudation, a surface of a moderate relief close to the base-level of erosion, an almost plane surface, a "peneplain"—the evidence of this being found in the even uplands of the crystalline plateaus which now inclose the Triassic valley on the east and west. No explanation for the evenness of these plateaus can be found save the one which regards them as having been reduced from some greater mass by a long-continued process of erosion, at a time when the region stood somewhat lower than now—low enough to place the present plateau-like uplands close to sea-level; and the sandstones, shales, and lava-sheets between the two plateaus undoubtedly suffered the same denudation. This is indicated in Fig. 11, in which all the upper part of the model as shown in Fig. 10 has been removed; the obliquely beveled surface of the beds now represents the lowland of denudation, or peneplain, to which they were reduced. The effect of the oblique faulting is now rendered apparent by the dislocations in the belts of the different outcrops. The main sheet of lava, for example, is seen in each of the blocks into which the formation is divided by the faults; so is the belt of shales lying under it, and so on with every member of the series.

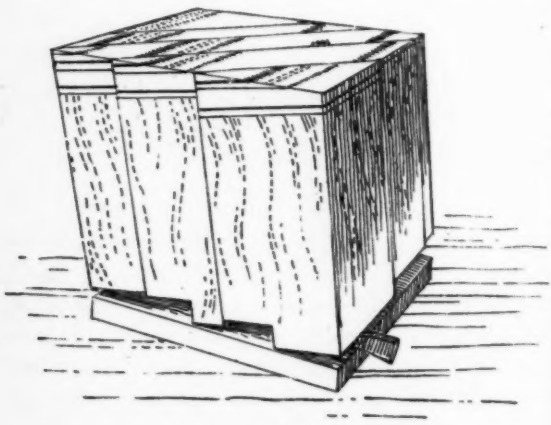


FIG. 11.

Indeed, the reader must perceive that it is only because the actual facts of observation are thus arranged that the existence of the faults is inferred. Most of the faults are of moderate displacement; but just north of Meriden there is one whose movement amounted to two thousand feet; it cuts off the northern end of the main lava-sheet in Lamentation and the southern end of the same in the Hanging Hills group of lava-ridges. In following along the line between these two dislocated portions of the sheet, every ridge formed by the more resistant sandstones or conglomerates is cut off in a most systematic manner, precisely according to the pattern shown in the beveled surface of the model. The railroad crosses this great fault about a mile above Meriden, but the traveler will see nothing there to indicate the dislocation; its constructional effects have all been worn out.

But the region is not now a plain. It is a rolling lowland with occasional ridges formed on the resistant edges of the lava-sheets. The cause of this is found in a moderate uplift of the whole country since it was reduced to a peneplain, introducing the second chapter in the history of its erosion. After this uplift a new cycle of erosive work was undertaken, and we now find ourselves at a moderate advance in this division of the valley's history. The softer beds have wasted away into lowlands, the harder ones still stand up as ridges. In the adjoining crystalline areas on the east and west, where most of the rocks are hard, the erosion of this cycle has made comparatively little progress; there the valleys are narrow and the interstream spaces are rolling uplands. In the Triassic belt, where most of the rocks are soft, the erosion of the same cycle has made much greater progress and reduced the area nearly to a second peneplain, except where the edges of the hard lava-sheets still hold up their crest lines to give some indication of the elevation that the whole surface once had. Here the valleys are broad and the interstream highlands are reduced to narrow ridges. This stage is indicated for our ten-mile-square area in Fig. 12, produced by removing from the previous form of the model certain little slips by which

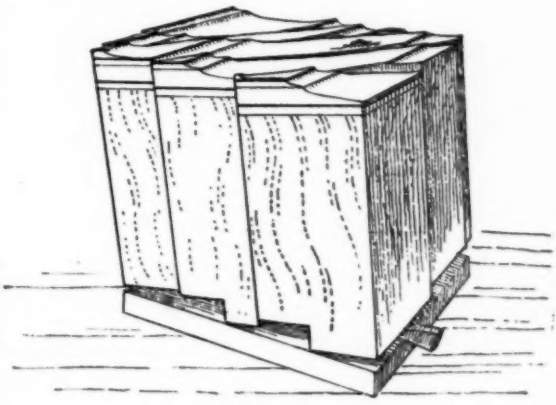


FIG. 12.

it is transformed from a peneplain to a broken country. It is practically in this stage that the region now stands. It has suffered certain slight changes by glaciation, and by small variations of level; but its main features are explained in accordance with the scheme thus presented; and from this general sketch we may return to the more especial consideration of the lost volcanoes.

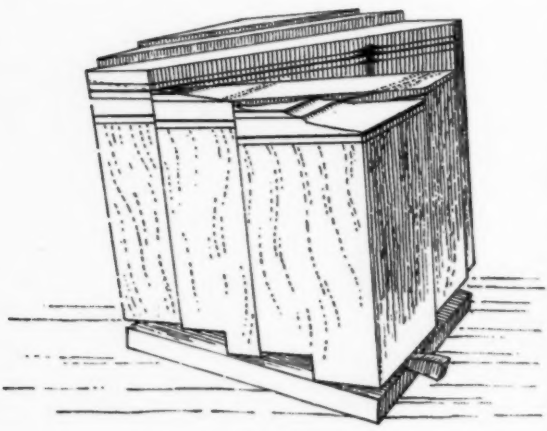


FIG. 13.

Fig. 13 presents a partial dissection of the tilted and faulted mass, in order to show the relation of the peneplain, produced at the end of the first cycle of erosion, to the volcanoes from which the lavas were poured out. The near corner block is stripped down to the present stage of topographic form; the second represents the peneplain stage; the other three retain their constructional form. It is here made apparent that by reason of the tilting, the volcanic cones were raised above the old base-level of erosion, and were hence doomed to destruction in the process of base-leveling. The further edges of their flows remain; the stump of the long chimney up through which their lavas rose to the surface is still discoverable, but the cones, where the chimney rose to the surface and gave forth the flows, are lost. Fig. 11, which represents the completed peneplain, has no trace of them, although the edges of the flows and the stump of the chimney can be identified. Fig. 12, illustrating the present form of the surface in a general way, shows no volcanoes, but it shows the edges of the flows and the stump of the chimney better than before, because they, being hard rocks, have held up their edges, while the surrounding weaker sandstones and shales have wasted away. Thus the Blue Hills have been developed; not by lifting up their heavy summits above the surrounding surface, but by holding hard to the form that they had at the end of the previous cycle, while the surrounding rocks have lost it. Denudation has not yet progressed deep enough to reveal the connection that very likely exists between the chimney and the lower intrusive sheet; this is still buried. Fig. 14 tells the same sequence of events, but in very diagrammatic style.

The wooden working model from which several of these fig-

ures are taken is a very wooden affair; it is rigid and straight-lined, instead of varying in irregular curves after a natural fashion; yet it may serve to present concrete illustrations of the successive stages through which the Meriden district has passed; and when thus viewed, the interest of the place grows wonder-

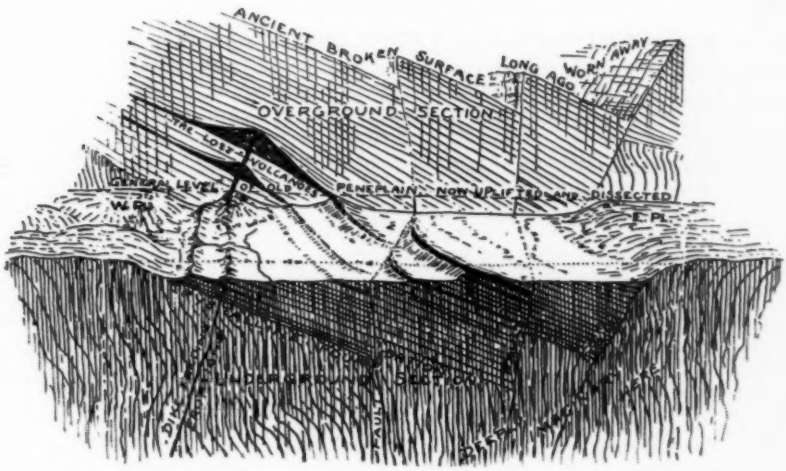


FIG. 14.—DIAGRAMMATIC VIEW OF A FAULTED MONOCLINE, between crystalline plateaus on east (E. Pl.) and west (W. Pl.), to illustrate the general structure of the Connecticut Triassic belt. Relative breadth much reduced. The supposed underground structure is shown in a vertical section in the foreground, and the inferred overground structure (now lost by erosion) in a vertical section in the background. A strip of actual surface lies between the two sections. The even peneplain, to which the whole mass was first reduced, is shown by dotted lines at the level of the eastern (E. Pl.) and western (W. Pl.) crystalline plateaus.

fully. Its scenery is not grand or magnificent; many other regions exceed it in height of mountains or depth of valleys; but it has a fine story to tell about its lost volcanoes, and it tells the story with great distinctness and emphasis when the listener passes by.

IMPORTANT literary discoveries have attended the labors of Egyptologists during the present year. In January was announced the recovery of nearly a complete copy of the lost work of Aristotle on the Constitution of Athens—a document which throws new light on important events in Grecian history from the time of Solon down to the age of Pericles. The examination of the papyrus leaves of which certain coffins found at Tel Gurot, in the Fayoum, were made, has resulted in the recovery of several fragments of ancient literature of greater or less value; the most notable of which are a large part of a lost play, Antiope, of Euripides, and of parts of the Phædo of Plato, of a copy nearly contemporaneous with the authors, and furnishing a purer text than those from which the modern editions of this work are derived. Much was expected from the papyri found with the one hundred and sixty-three priestly mummies which were discovered last spring at Deir-el-Bahari, near Thebes; but, so far as they have been examined, they have afforded nothing more valuable than funereal texts.

THE TRAINING OF DOGS.*

By WESLEY MILLS, M. D.

AN analysis of our own psychic life, complex as much of it is, compared with that of the dog, shows that a great part of our mental processes are not concerned with abstractions and generalizations of a very high order, but with actual concrete perceptions and conceptions; that we think in pictures rather than words; that our thoughts are the result of past associations; that the machinery of the mind or brain is so connected that when one part is moved, so to speak, a whole series of connections are established. Hence the psychic life of every creature must be related essentially to its past experiences.

If this be true—and it can not be doubted—we think, then, the puppy's intelligence, like our own, begins to develop, and continues to do so exactly in relation to its environment. We can make that environment pretty much what we will; and with the dog, his master from the first, and always, is the principal factor.

Two extreme views have for a long period been entertained in regard to the training of the dog; the one that he is a wild, wayward creature to be "broken," the other that he needs no special correction if properly taught from the first. Neither is quite correct.

A puppy full of life tends to do exactly as his impulses move him, till the highest motive power, a desire to please his master, is substituted. It follows that a puppy can not be too soon led to understand that he has a master—kind, honest, intelligent, and firm. He must be consistent with his puppy. All caprice is fatal; it utterly confuses and demoralizes the dog.

Remembering that principle we laid down long ago, that the dog is very like ourselves, we can indicate a few principles for training that we think will meet the test of experience. The puppy at one period is like a young infant, later like a two-year-old child, and at the best most dogs never get beyond the intelligence of a young child in most respects, though in some qualities the wisest man is far behind the dog.

For practical purposes the puppy may be treated as an infant, but as a rapidly developing one. He gets his information through his senses, and his training must be related to this, and to the fact that he is a creature with strong impulses but little self-control.

It is a well-established law of the nervous system that what has happened once is likely to occur again under the same circum-

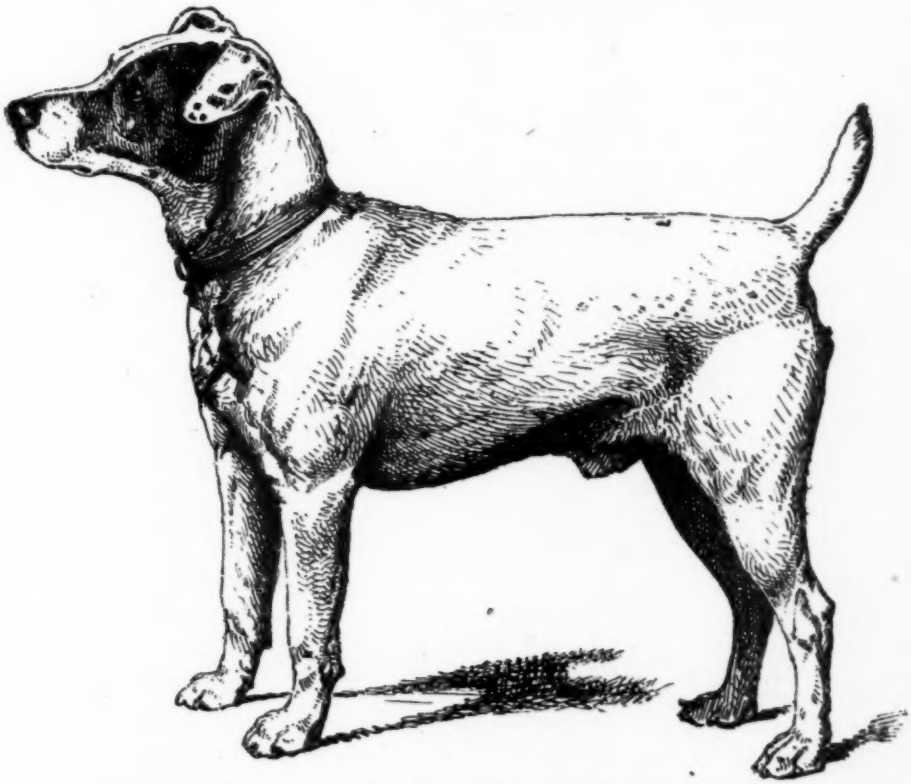
* From advance sheets of the author's book, The Dog in Health and Disease, in preparation by D. Appleton & Co.

stances; hence in the training of puppies first experiences are of much importance, and all the arrangements of the kennel, and in fact the whole environment, should be shaped in relation to this principle.

The puppy should not be allowed to get into habits which will later need correction. Let him from the first be encouraged in cleanliness, self-respect, love of esteem, respect for the rights of other puppies, his fellows, etc.

Very early begin to instill into him lessons of restraint, but only for the briefest periods, for the creature is as yet weak in brain and will power, though strong in instincts and impulses.

The master or trainer must not be associated in his mind with



THE SMOOTH-COATED FOX-TERRIER CHAMPION THE BELGRAVIAN.

unpleasantness, but with the reverse. Do not, therefore, punish him, but let him learn almost unconsciously that certain actions and certain pleasures are connected.

He should soon learn his name, should always come when called, but not be summoned too often, especially if playing. It is well to carry a bit of biscuit, cheese, etc., to reward him for coming at first. Later a pat of approbation will suffice.

The trainer should never undertake what he is not reasonably sure of accomplishing; and the first aim should always be to secure the dog's attention and interest, and to make the accomplishment pleasant. But he must know what is wanted, and if he can not comprehend this, the lesson is unsuitable at this period. He must, however, obey if he understands; gentle compulsion,

THE GREYHOUND FULLERTON. Thrice winner of the Waterloo cup, the most valuable of all coursing prizes.

when once the purpose is understood, may be exercised—e. g., if he will not come when he is called, he must not be whipped, as that will make the whole set of associations unpleasant, but he must be gently dragged by the back of the neck or bodily carried to where the trainer stood when the command was given; he must then be very gently reprimanded, then forgiven and made to feel that he is forgiven, and the lesson repeated, always rewarding obedience in some way.

Obedience to what is right pleasant, disobedience unpleasant, is the rule for us all, dogs and men. On these principles yard and house training is simple with well-bred dogs. They mean to please if they can. Make obedience and right-doing understood,

possible, and pleasant, and it will be preferred, especially if the wrong-doing is followed by the reverse experiences.

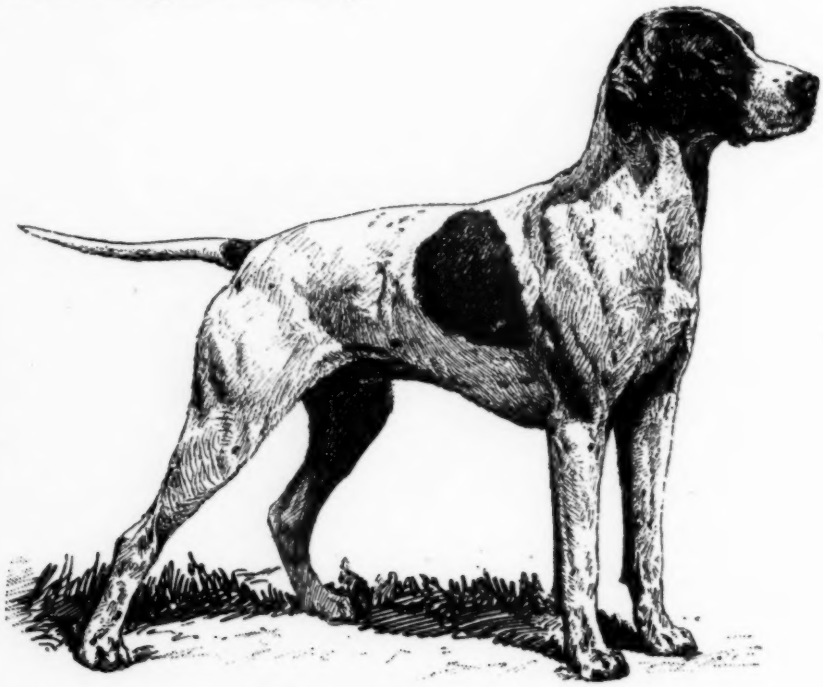
Dogs are not filthy in their habits, but some people who keep them are, and others do not understand what is required to enable a dog to follow his instincts of cleanliness. Where a dog has once been to respond to Nature's call, he tends to visit again, and this is a guide to enable us to avail of natural instinct to enable us to maintain cleanly surroundings. The same general principles apply when dogs are taken afield to be worked on some sort of game. At first the puppy may run toward almost every form of life he sees. This is natural, and he would not be worth his keeping if he did not show some such tendency to investigate the world about him.

Bob-tail Sheep Dog.

But he must be restrained gradually. He must associate certain acts with the approval and others with the disapproval of him he respects, loves, and wishes greatly to please if he only knows how.

But such is the strength of the impulses of some puppies—now, we will suppose, six or eight months old—that they find it very difficult to restrain themselves. In such case we must lessen the stimulus or source of excitement rather than resort at once to the application of the principle of making the act unpleasant, as the use of a spiked collar or check-line.

These may later be useful in a modified form, but not at first; indeed, such methods are mostly quite unnecessary if a proper course be pursued. To illustrate: Suppose that a brace of setter puppies eight months old be taken to some wood where there is but little game. If they tend to run wild without any reference to the whereabouts of the trainer, and disregard his calls or his whistle, it surely would not be wise to whip those puppies soundly at once, attach a spiked collar or a check-line. To do so would probably confuse them, humiliate them, and retard their development in every way. Now, if the trainer secrete himself for a little while, these puppies will probably get frightened a little, feeling that they are lost, and will after this be more cautious how widely they range. When they do come in they may be scolded, but not whipped at this stage.



THE POINTER CHAMPION BRACKET.

It should be pointed out that all dogs should be taught to come in to whistle and to "down charge," or to drop at some word of command or at the upraising of the hand. This applies to all breeds, though more especially to dogs used in shooting. A dog in the field should also be guided by the motions of his trainer's hand. In learning this, the voice, the whistle, and often a long cord will be useful.

But the author wishes to avoid giving the impression that

there is only one way of accomplishing these things, as many previous writers seem to have thought, with the result that many who have attempted to follow these rigid rules have disgusted themselves and spoiled their dogs.

It is to be remembered that all lessons require frequent repetition. "Little and often" applies to training as a cardinal principle.

THE BLOODHOUND CHAMPION CROMWELL.

No one should undertake the training of a dog to work on game who is not possessed of patience and good temper. Lacking these, the puppy is apt to cause the trainer great worry and to get little good from him, if he be not actually spoiled. It is, in fact, better to go afield expecting that the puppy will do nothing as desired at first; then one is prepared for the worst, and may soon lay his plans to accomplish what he aims at, which must always be done in relation both to the dog and the circumstances.

But with dogs example is strong for good or evil. A steady, old trained dog is invaluable, while a disobedient, headstrong one will most assuredly ruin the puppy. But it is clearly foolish to expect a puppy under a certain age to work on game with an older dog—indeed, to work on game at all—though ranging, obeying the whistle, dropping, etc., should all be taught be-

fore the puppy is introduced to game. He must learn restraint and obedience, though it must be confessed that a day's work on actual game often quite transforms some puppies. But, as a rule, ten or twelve months will be quite soon enough to introduce a puppy to actual work.

Retrieving may be taught at home, using a soft ball of yarn, etc.; and if the puppy tends to bite on this, a few wires may be pushed through it. He must always at first be rewarded, when he brings the ball when thrown, with a little meat, cheese, etc. The words "fetch," "seek," etc., may be employed. Soon he will

THE IRISH WATER-SPANIEL CHAMPION SHAUN.

understand, and seek when no ball is thrown. To get him to "seek dead," some article may be hidden, and at first some meat, etc., must be employed, and the dog assisted to find it. Later a real bird may be used, or a wing. The same word of command should always be used. If the puppy will not bring the article—will not retrieve—take him to the spot and place it in his mouth,

holding it there and obliging him to carry it and finally deliver it to his trainer; reward him, and then try him again.

Some dogs take to retrieving naturally, requiring no training, while it is almost impossible to get others, often of high intelligence, to learn this at all.

Most puppies need a good deal of attention before they are perfectly steady on point, and to wing and shot, as their natural tendency is to secure the game when they have found it. How best to overcome this it is not always easy to decide. The dog must be encouraged to remain steady while his trainer moves up. Often the assistance of a second person to flush the bird will be

THE ROUGH-COATED ST. BERNARD CHAMPION SIR BEDIVERE.

useful, while the dog is approached and encouraged but not allowed to rush on. In this case a check-cord may be useful—to be employed as little as possible. The example of a reliable old dog is invaluable. Some form of check that will make the dog defeat or punish himself is preferable to direct administration of punishment by the trainer.

Gun-shyness is but an exaggerated form of fear of unusual noises, and must be treated accordingly. Let the dog be gradu-

ally introduced to louder and louder noises, never being allowed to escape, but being made to see that no harm is meant him or can happen to him. As to whether it is worth while to attempt to cure the worst cases will depend much on other circumstances, as the dog's breeding, general intelligence, nose, etc. It may or may not be inherited.

The author, in conversation with a very successful trainer of horses, once asked: "Can you teach any horse these things?" "I can do so, but it would not in many cases be worth while," was the reply. The same may be said of dogs: some of them are not adapted for certain kinds of work, and acquirements by nature to a sufficient degree, to make it worth while to persevere in teaching them; just as certain boys would never become expert enough at certain vocations to warrant their pursuit. But before abandoning a well-bred dog that seems to possess courage, "go," and fair general intelligence, it might be well to get the advice of some second person of much experience. Many dogs, unpromising at first, have become a great success afterward. The ability to read dogs very thoroughly is given to but a few men, and these, provided they have patience, good temper, and perseverance, must of course make the best trainers.

Though we have spoken chiefly of the training of hunting dogs, it is simply because that is usually more elaborate. All training is based essentially on the same principles, for the mind of the trainer and that of the dog are relative constants, while the circumstances are the variables.

In every instance the dog, from the earliest period, must know the trainer as his master, as one who knows his own mind and always is to be obeyed. But, in order to insure this, the principles we have already endeavored to enforce must be faithfully and intelligently applied; and it is very important, we repeat, that nothing be undertaken that can not be performed, and every advance in instruction approached by slight gradation and frequent repetition. All sound training must constantly keep in mind the individuality of the animal. The assumption that all dogs can be treated just alike is as erroneous as that all stomachs may have the same diet.

A dog kept constantly in a kennel can never attain his highest psychical development; and it is the author's experience that it does every dog good to bring him into the house occasionally for short periods and allow him to mingle with the family. It raises the animal in his own estimation, and attaches him to his master, for whom he will have increased respect.

SILK DRESSES AND EIGHT HOURS' WORK.

By J. B. MANN.

THE remark occurs in a recent editorial article in a prominent religious newspaper commending the eight-hour movement that if all the women who want silk dresses could have work, all the silk factories in the country could be set in motion and would furnish employment to the many thousands of people then idle; or words of that import. The proposition at first sight seems philosophical, but is it not reasoning in a circle? Having work, people will buy silks. If they buy silks, the factories will run. If the factories run, the people will have work. The old lady said: "This snow will never melt until the weather is warmer, and the weather can never be warmer until the snow has melted." Making the statement does not solve the problem.

When we look at the matter with care we find, sorrowfully, that the women who have no silks are the very ones who do the hardest work; and hence, as they are working clear up to the limit of human endurance to get bread, they have no time left over to put into silk dresses. This fact upsets the theory. Horace Greeley had a theory that poverty in cities could be cured by getting the poor to go West and engage in farming; entirely overlooking the fact that the next sixpence the poor man could get, and the next, and so on, must go for bread, thus putting a trip to the West out of the question.

But the imagining of philosophers in regard to the remedies is of small account, because want of work is not in this country one of the leading causes of poverty, as every careful observer knows. There are at least a dozen things which are more potent causes of the evil, and too much work, by which constitutions are broken and health ruined, is one of them. Is the remedy, therefore, not to be found in the eight-hour movement? I answer, No. The eight-hour movement does not approach the root of the evil. It is assumed by the promoters of the movement that society has a given amount of wants which require a given amount of labor to supply, and hence it is inferred that if all the workers cut down their hours from twelve to eight, the men now out of employment will come up and do the work the others have relinquished. In that way it is claimed that there will be work for all. Another theory is that men will accomplish as much in the long run in eight hours as they now do in twelve. It is evident on the face of it that both theories are not true, because if as much should be done by the present workers after the change as before, no more would be left for the others to do than they have now. And in that case the present workers would come much nearer to ex-

hausting their strength and injuring their health for the same money only that they get now. They would be no richer, and would drive their muscles and frames at a wearing pace not consistent with the laws of health.

But neither theory is true. Instead of there being a given amount of wants, as alleged, wants are found to be largely the result of means.

If the community have little, they require little, but as they become wealthy they spread out in proportion. People can't hire labor if they are poor, and hence to make a demand for labor somebody must be rich enough to pay for it. This is perfectly plain. Nobody goes in search of a poor man for employment, only in the last resort. It follows that whatever tends to wealth-making tends to want-making, and to an increase in the demand for labor and the supply of employment. On the other hand, whatever tends to a diminution of wealth tends necessarily to a diminution of the means to pay for labor, and also to less disposition to hire others to do the work. I think that these positions can not be successfully combated, and if not, we have a criterion by which to determine in what direction to look for improvement in the condition of the laboring man. Surely we shall never find it in anything that tends to a diminution of resources.

What is stated above in relation to wants being increased in proportion to the increase of wealth does not hold good in some individual cases, but in general it does, and it holds good to that extent that the common people everywhere accept it as a basis of action without stopping to reason about it at all, it is so natural. It is the reason why people leave a country like Ireland and come here. They expect to find dollars so plenty that, according to the old story, they do not deem it worth the while to pick up the quarters they may see lying on the wharf where they land. The same thing takes the smart boys from the poor country districts and small villages to the large towns and cities. They feel that they must get to places where there is an abundance of money. They do not fail to note that a man who has ten thousand dollars will build a three thousand dollar house, while the man with thirty thousand will build a house costing twelve thousand probably, and that calls for four times the labor of the other. They must get where such men abound, and where there are hundred-thousand-dollar men and millionaires, men who will build palaces, railroads, great warehouses, and ships. Poverty-stricken places are given a wide berth by all sensible folk, and so universal is the practice that we are not left in doubt as to the meaning of it.

Now wealth is principally the product of labor. Some get it by their own labor, and some by the labor of others; but however got by the individual, it is the result of personal or machine ex-

ertion and force. This necessitates the rule, therefore: More labor, more wealth; less labor, less wealth. This rule no one can escape or ignore.

The question now comes up, whether working eight hours a day tends to more riches or more production than working twelve. That it does not, I have already stated is my belief, and the belief is founded upon a long experience as a mechanic, farm-laborer, employer, and observer. In twenty years of labor in a shop, I never saw the time when I could do twelve hours' work in eight hours, except possibly for a single day. I never saw the man that could do it, and I never heard of one that could do it.

I never met one that said he thought it could be done for any length of time. It is a well-established fact that most men that pretend to work well have a working gait of their own, and can not be hurried beyond that advantageously. If they are, they do poor work or break down. This is so obvious that any pretense that as much will be accomplished in the shorter hours in farming or physical labor of any kind borders on the ridiculous. So obvious is it, that the principal advocates of the eight-hour movement have ceased to put their case on this ground, and rely upon the other theory, that less work will be done, and consequently more work will be left to be given to the laborers seeking for something to do.

If this latter view be adopted, it follows that the eight-hour men are philanthropists, who have sacrificed, or propose to sacrifice, one third of their possible earnings for the good of their fellow-men who have no work. This is incredible. The laborers themselves do not act from any such principle. They are thinking all the time that, instead of making a sacrifice, they are getting more leisure and making more money. They think that, instead of the work they could do in the four hours they have abandoned being done by the poor fellows who need help, it is not done at all, and, not being done at all, wages have risen, and thus they can get twelve hours' pay for eight hours' work.

In other words, they propose to increase the wealth of the community by lessening the amount produced by the community, thinking that, with a smaller amount to be divided as wages by one third, they can get a bigger share. Not only do they suppose this impossible thing, but they claim it has already been accomplished, and they say the advance in wages during the last thirty years has been caused by the reduction of hours.

Assuming this to be true, it is perfectly legitimate to argue that a further reduction of hours will work in the same way, and they name eight as the next station on the scale, with an intimation that soon six will be the point, and later four. I believe that most concede that it is necessary to have some work done, not

perceiving the absurdity into which they fall by the concession. Logically, we say that if one can earn a dollar in one hour, he can earn the same the next hour, and the next, and so on to the limit of his endurance. But, if we begin at the other end of the line of argument, and say that one can do as much and get as much pay in ten hours as in twelve, and then say that he can get as much pay in eight as in twelve, and then again as much in six, there is no logical stop anywhere till the bottom is reached. The stubborn fact of time is kicked out of the back door. It is the same as saying that a man works six hours, earns three dollars, and then works six more at the same work for nothing; while the same persons who say it have to admit that, if the man worked six hours in one day and six hours the next day, he would get as much pay for the second six as for the first six. Time is too tough a customer to be disposed of in that manner, and we must deal with him as a fact that has come to stay.

I think the most stupid are now able to see that one's ability to provide for his wants depends primarily upon his labor, and that time is a principal element in the case. He must have it and he must use it, and his prosperity, other things being equal, will be much or little as time is wisely used or neglected. The law of prosperity has not been repealed by any of the edicts of the leagues and unions. Not a fact or principle has been abolished or suspended. An hour lost is the loss of the product of labor that might have been performed in that hour, and it falls on the man who owned the hour, and not on another man or set of men. He does not escape his loss by the absurd theory that he lost it after four o'clock of Monday, instead of before ten Tuesday morning. It is an absolute loss, whatever the day when it was made. If the man worked for himself, as the saying is, he would see it was a total loss and nothing else; but, working for another, he fancies the other man is the loser, or else, by some hocus-pocus, it is shifted upon society. If men worked by the piece they would see how it is. Let two men start together in life as shoemakers, with a view to do their best in getting on in the world, as Henry Wilson did sixty years ago. They are equal in skill and endurance, and can work twelve hours at a fair stroke without impairing health. Working by the piece, they find they can earn sixteen and two thirds cents per hour, or at the rate of two dollars a day. There is no difference between them in purpose, and only the small difference in the method of getting on, that James thinks he will sooner get in comfortable circumstances by working twelve hours a day, and John imagines that nine hours will answer the purpose just as well. At the end of the year of three hundred days they find that James has earned six hundred dollars, and John has earned but four hundred and fifty dollars.

They keep on at this rate ten years, and James has laid by two thousand dollars, and John nothing. Now, the two thousand of James earns ten dollars a month for him, and is better than a good apprentice, because he pays the fund no wages and it costs nothing for board. The reason why they are now so wide apart is that the extra hours of James have yielded fifteen hundred dollars principal in the ten years, and five hundred dollars in interest. John has nothing, because the expense of living of each and support of the families has amounted to four hundred and fifty dollars a year for each. In ten years more James will have interest-money sufficient to meet the family expense of four hundred and fifty dollars, and John will be with his nose still on the grindstone. A company of ten such men would lose in ten years twenty thousand dollars, and society would never make it up to them. Society would not pay for one hundred pairs of shoes when only seventy-five pairs were furnished, and the idea that it would is a delusion. Many workingmen have gained in the last half century, and the general condition has improved a great deal, but no part of the money gain has been due to less hours of labor. The people have grown rich during that time because they have availed themselves of the increased means of production which have been developed, and not because production has been lessened by the laborer refusing to work the former number of hours. Our riches are made up entirely of things produced, and when we say we are richer, we mean that we have more things which are the product of applied force. The increase of wealth, as was stated before, has increased the disposition to build more expensive houses and buy more elaborate furniture, and have an endless variety of things deemed needless a few years ago, causing a demand for labor and an increase of wages that in a measure counterbalances the loss of time. This is what has helped labor, and not the refusal to work more than ten hours. Had the other two hours a day been worked, the laborer would have been still richer by one sixth of the principal and all the interest on his extra earnings during the whole time that the ten-hour rule has prevailed. The workman, then, has simply exchanged the wealth he might have got in the extra two hours for leisure of two hours; a very proper thing to do if he can afford it, but he hasn't had the leisure and the money he might have earned in the lost time also.

The community is also the poorer to the same extent. It misses just the amount of wealth that the laborer has failed to produce in his idle hours. It finds on its hands a large body of men advanced in years who might now be comfortable, but are still struggling to meet the cost of increase in the style of living consequent on the increase of wealth, when they are more than one sixth short in possible resources.

The trouble with the eight-hour plan, however, is not here so much as in the fact that so many men who can not get a decent living on eight hours of labor are taught that they can earn as much in that time as in twelve hours, and are made to believe it, or else denounced as scabs and nobodies. If the laborer attempts to work more hours, he is called an enemy of workingmen, an enemy of progress, and so on, until he is forced to a life of partial idleness, while his children are suffering for comforts which his labor could furnish without injury to himself or to any mortal in the world. There are hosts of men somewhat deficient in skill who could partially make up in longer hours their lack of efficiency were they permitted to, but as they are not, they are forced to live on the verge of beggary all their days, and are taught to curse society for not giving them a better chance in the world. How many such there are in this country God only knows, but that they are numerous there can be no doubt. The evil is prodigious, and is not confined to this class entirely. Others are affected in an unfavorable way. The idea is encouraged that labor is an evil to be shunned like vice, and that there is a way to enjoy the fruits of labor without its exercise. The consequence of the prevalence of this idea is, that men are led to hope for the impossible, to trust in its coming, and to neglect the golden opportunities for making their way which lie directly before them. The man who thinks he is getting richer by three or four hours of idleness every day is not likely to set much value on time, and when he does not do that, he tends to unthriftiness, and in time will become a good deal of an idler if not a downright loafer. When the whole community becomes thus affected, the consequences will be serious. They are serious already.

That this is a remarkable age in which we live is the general belief, but of the things that go to make up this belief nothing is stranger than the fact that when all mankind were devoting their best thoughts to the discovery of ways to increase resources and add to the general and individual wealth of society, when schemes of all sorts were being devised to save time in transportation of goods and mails and persons, in planting corn and making hay, in pumping water and feeding cattle, in tanning leather and making whisky, in mounting flights of stairs and raising broods of chickens—the workingmen as a body should band together and contrive a scheme to compel all hands to throw away absolutely one fourth of their chances to earn and lay up money, and provide for that period sure to come to all who live out the allotted years of man, when leisure will be not merely a luxury but a necessity; yet this is exactly what they have done. They have in a considerable degree neutralized the gains to themselves to be derived from the use of machinery, and thus have allowed the machines

to stand on the pay-rolls for the one quarter of wages they might have earned themselves. It was formerly supposed a wise saying that "the hand of the diligent maketh rich," but the proverb has been strangely modified in these days.

We are now told that the proverb was only three quarters true, and instead we must say, the man who works all of working time makes his neighbors poor, and will spend his last days in the work-house of the parish or on the highway as a tramp. Time lost is money lost to the one to whom the time belonged, whether he be rich or poor. The rich can lose some without feeling it, but the poor, alas! have none to spare. When this truth is fully appreciated by the destitute, a long stride will have been made toward the extinction of poverty.

DUST.

By J. G. McPHERSON.

SOME of the most enchanting phenomena in nature are dependent for their very existence upon singularly unimportant things; and some phenomena that in one form or another daily attract our attention are produced by startlingly overlooked material. What is the agent that magically transforms the leaden heavens into the gorgeous afterglow of autumn, when the varied and evanescent colors chase each other in fantastic brilliancy? What is the source of the beautiful, brilliant, and varied coloring of the waters of the Mediterranean, or of the most extraordinary brilliant blue of the crystal waters of the tarns in the Cordilleras? What produces the awe-inspiring deep blue of the zenith in a clear summer evening, when the eye tries to reach the absolute? Whence come the gentle refreshing rain, the biting sleet, the stupefying fog, the chilling mist, the virgin snow, the glimmering haze, or the pelting hail? What raises water to the state of ebullition in the process of heat application for boiling? What is the source of much of the wound putrefaction, and the generation and spread of sickness and disease? What, in fact, is one of the most marvelous agents in producing beauty for the eye's gratification, refreshment to the arid soil, sickness and death to the frame of man and beast? That agent is *dust*.

And yet no significance is given to dust unless it appears in large and troublesome quantities. It requires the persistent annoyance of dust-clouds to excite any attention. Dust, however, demands to be noticed, even when not in that collected, irritating motion known in Scotland as *stour*. The dust-particles floating in the atmosphere or suspended in the water have a most impor-

tant influence upon the imagination, as well as upon the comfort of man. Though so small that a microscope magnifying 1,600 diameters is required to discern them, they at times sorely tax the patience of the tidy housekeeper and the skill of the anxious surgeon. An æsthetic eye is charmed with their gorgeous transformation effects; yet some are more real emissaries of evil than poet or painter ever conceived.

Until the famous discovery made by Mr. John Aitken, of Falkirk, a few years ago, no one could reasonably account for the existence of rain. It was said by physicists that cloud-particles were attracted by the law of gravitation under certain conditions of temperature and pressure. But this famous experimentalist and observer found out that without dust there could be no rain; there would be nothing but continuous dew. Our bodies and roads would be always wet. There would be no need for umbrellas, and the housekeeper's temper would be sorely tried with the dripping walls.

A very easy experiment will show that where there is no dust there can be no fog. If common air be driven through a filter of cotton-wool into an exhausted glass receiver, the vessel contains pure air without dust, the dust having been seized by the cotton-wool. If a vessel containing common air be placed beside it, the eye is unable to detect any difference in the contents of the vessels, so very fine and invisible is the dust. If both vessels be connected with a boiler by means of pipes, and steam be passed into both, the observer will be astonished at the contrast presented. In the vessel containing common air the steam will be seen, as soon as it enters, rising in a close white cloud; then a beautiful foggy mass will fill the vessel, so dense that it can not be seen through. On the other hand, in the vessel containing the filtered, dustless air, the steam is not seen at all; though the eye be strained, no particles of moisture are discernible; there is no cloudiness whatever. In the one case, where there was the ordinary air impregnated with invisible dust, fog at once appeared; whereas in the other case, the absence of the dust prevented the water-vapor from condensing into fog. Invisible dust, then, is required in the air for the production of fog, cloud, mist, snow, sleet, hail, haze, and rain, according to the temperature and pressure of the air.

The old theory of particles of water-vapor combining with each other to form a cloud-particle is now exploded. Dust is required as a free surface on which the vapor-particles will condense. The fine particles of dust in the air attract the vapor-particles and form fog-particles. When there is abundance of dust in the air and little water-vapor present, there is an over proportion of dust-particles; and the fog-particles are, in consequence,

closely packed, but light in form and small in size, taking the more flimsy appearance of fog. But if the dust-particles are fewer in proportion to the number of molecules of water-vapor, each particle soon gets weighted, becomes visible, and falls in mist or rain.

This can be shown by experiment. Let a jet of steam be passed into a glass receiver containing common air, and it will be soon filled with dense fog. Shut off the steam and allow the fog to settle. The air again becomes clear. Admit more steam, and the water-particles will seize hold of the dust-particles that previously escaped. Fog will be formed, but it will not be so dense. Again, shut off the steam, and allow the fog to settle and the air to clear. Then admit some steam, and very likely the condensed vapor will fall as rain. If the experiment be often enough repeated, rain instead of fog will be formed, because there are comparatively few solid particles on which the moisture can condense. When, then, dust is present in large quantities, the condensed vapor produces a fog; there are so many particles of dust to which the vapor can adhere that each can only get a very small share—so small, in fact, that the weight of the dust is scarcely affected by the addition of the vapor—and the fog formed remains for a time suspended in the air, too light to fall to the ground. But when the number of dust-particles is fewer, each particle can take hold of a greater space of the water-vapor, and mist particles or even rain-particles will be formed.

This principle that every fog-particle has embosomed in it an invisible dust-particle led Mr. Aitken to one of the most startling discoveries of our day—the enumeration of the dust-particles of the air. Thirty years ago M. Pasteur succeeded in counting the organic particles in the air; these are comparatively few, whereas the number of inorganic particles is legion. Dr. Koch, Dr. Percy Frankland, and others have devoted considerable attention to the enumeration of the micro-organisms in the air, and Mr. A. Wynter Blyth, the public analyst in London, has done good service in counting the micro-organisms in the different kinds of water in the vicinity. Marvelous as are the results, still the process was comparatively easy. By generating the colonies in a prepared gelatin, the number of microbes can be easily ascertained.

But to attempt to count the inorganic dust seemed almost equal in audacity to the scaling of the heavens. The numbering of the dust of the air, like the numbering of the hairs of the head, was considered as one of the prerogatives of the Deity. Yet Mr. Aitken has counted the "gay motes that people the sunbeams." Though he could not enlarge the particles by a nutritive process, as in the case of the organic particles, he has been able to enlarge them by transferring them into fog-particles, so as to

be within the possibility of accurate enumeration. His plan is to dilute a definite small quantity of common air with a fixed large quantity of filtered, dustless air, and allow the mixture to be supersaturated by water-vapor; the few particles of dust seize the moisture, become visible in drops, fall on a divided plate, and are there counted by means of a magnifying-glass.

The instrument employed by Mr. Aitken has taken various forms; in fact, he has so far improved it that it can be carried in the coat-pocket. But the original instrument, which we saw and used, is most easily described without the aid of diagrams. But, instead of his decimal system of measurements, we will use the ordinary system, that the dimensions may be more easily grasped by the general reader. Into a common glass flask of carafe-shape, and flat-bottomed, of thirty cubic inches capacity, are passed two small tubes, at the end of one of which is attached a square silver table, one inch long. A little water having been inserted, the flask is inverted, and the table is placed exactly one inch from the inverted bottom, so that the contents of the air above the table and below the bottom are one cubic inch. The observing table has been divided into a hundred equal squares, and is highly polished, with the burnishing all in one direction, so that during the observations it appears dark, when the fine mist-particles, falling on it, glisten opal-like with the reflected light, in order that they may be more easily counted. The tube to which the silver table is attached is connected with two stop-cocks, one of which can admit a small measured portion of the air to be examined. The other tube in the flask is connected with an exhausting syringe, of ten cubic inches capacity. Over the flask is placed a covering colored black in the inside. In the top of this cover is inserted a powerful magnifying-glass, through which the particles on the silver table can be easily seen and counted. A little to the side of this magnifier is an opening in the cover, through which light is concentrated on the silver table. This light, again, has had to pass through a spherical globe of water, in order to abstract the heat rays, which might vitiate the observations.

To perform the experiment, the air in the flask is exhausted by the syringe. The flask is then filled with pure filtered air. One tenth of a cubic inch of the air to be examined is then introduced into the flask, and mixed with the thirty cubic inches of dustless air. After one stroke of the syringe this mixed air is made to occupy an additional space of ten cubic inches; and this rarefying of the air so chills it that condensation of the water-vapor takes place on the dust-particles. The observer, looking through the magnifying-glass upon the silver table, sees the mist-particles fall like an opal shower on the table, and counts the number on a single square in two or three places, striking an

average in his mind. Suppose the average number upon one of these squares were five, then on the whole table there would be 500; and these 500 mist-particles contain the 500 dust-particles which floated invisibly in the cubic inch of mixed air above the table. But, as there are forty cubic inches of mixed air in the flask and syringe, the number of dust-particles in the whole is 40 times 500 = 20,000; that is, there are 20,000 dust-particles in the small quantity of common air (one tenth of a cubic inch) which was introduced for examination; in other words, a cubic inch of that air contains 200,000 dust-particles—nearly a quarter of a million.

By this process Mr. Aitken has been able to count 7,500,000 of dust-particles in one cubic inch of the ordinary air of Glasgow. We counted with him 4,000,000 in a cubic inch of the air outside of the Royal Society Rooms, Princes Street, Edinburgh. Inside the room, after the Fellows had met for two hours, on a winter evening—the fire and gas having been burning for a considerable time—we found 6,500,000 in a cubic inch of the air four feet from the floor; but near the ceiling no fewer than 57,500,000 were counted in the cubic inch. He counted in one cubic inch of air immediately above a Bunsen flame the fabulous number of 489,000,000 of dust-particles. The lowest number he ever counted was at Lucerne, in Switzerland: 3,500 in the cubic inch. On the summit of Ben Nevis the observer, using Mr. Aitken's apparatus, counted from 214,400 down to 840 in the cubic inch. But on the morning of the 21st of July last there was a most marvelous observation made. Though at the sea-level the wind was steady, and the thermometer did not vary, at the summit the wind suddenly veered round to the opposite direction of that below, blowing out of a cyclone, and the temperature rose ten degrees. In consequence the extraordinarily low mean of only thirty-four dust-particles to the cubic inch was observed.

We now come to the most pleasant of the investigations in connection with dust. The very brilliant sunsets which began in the autumn of 1883, and continued during successive seasons with gradually decreasing grandeur, have arrested the attention of the physicist as well as of the general observer. What is the cause of the brilliant coloring in these remarkable sunsets? What is the source of the immense wealth of the various shades of red which have been so universally admired? Gazing on a gorgeous sunset, the whole western heavens glowing with roseate hues, the observer sees the colors melting away before his eyes and becoming transformed into different hues. The clouds are of different sizes and of all shapes. Some float virgin-like in silver folds, others voyage in golden groups; some are embroidered with burning crimson, others are like "islands all lovely in an emerald sea." And when the flood of rosy light, as it deepens into bright crimson, brings

out into bold relief the circlet of flaming mountain peaks, it is like a gorgeous transformation scene. Stranger still, when the sun sinks below the horizon, and a dull ashen gray has possessed the western heavens, what occasions the hectic flush on the eastern horizon? Gradually the clouds are tinged with light red from the eastern horizon all over the zenith; whence comes the coloring?

It is a strange coincidence that these remarkably fine sunsets have been since the tremendous eruptions at Krakatoa, in the Straits of Sunda. Along with the lava eruption there was ejected an enormous quantity of fine dust. The decks of vessels, hundreds of miles away, were covered with it. Mr. Verbreek computed that no less than 70,000 cubic yards of dust actually fell round the volcano. This will give an idea of the enormous quantity of dust still floating in the atmosphere, and drifting all over the world. In the upper atmosphere, too, there must always be dust, for without the dust no clouds could be formed to shield us from the sun's scorching rays; and of cosmic dust there must be a considerable quantity in the air, produced by the waste from the millions of meteors that daily fall into it. Mr. Aitken has ably shown that the brilliancy and variety of the coloring are due to the suspended dust in the atmosphere.

Observers of the gorgeous sunsets and afterglows have been most particularly struck with the immense wealth of the various shades and tints of red. Now, if the glowing colors are due to the presence of dust in the air, there must be somewhere a display of the colors complementary to the reds, because the dust acts by a selective dispersion of the colors. The small dust-particles arrest the direct course of the rays of light and reflect them in all directions; but they principally reflect the rays of the violet end of the spectrum, while the red rays pass on almost unchecked. Overhead deep blue reigns in awe-inspiring glory. As the sun passes below the horizon, and the lower stratum of air, with its larger particles of dust which reflect light, ceases to be illuminated, the depth and fullness of the blue most intensely increase. This effect is produced by the very fine particles of dust in the sky overhead being unable to scatter any colors unless those of short wave-lengths at the violet end of the spectrum. Thus we see, above, blue in its intensity without any of the red colors. When, however, the observer brings his eyes down in any direction except the west, he will see the blue mellowing into blue-green, green, and then rose color. And some of the most beautiful and delicate rose tints are formed by the air cooling and depositing its moisture on the particles of dust, increasing the size of the particles till they are sufficiently large to stop and spread the red rays, when the sky glows with a strange aurora-like light.

The dust theory of the splendor of sunset coloring is strengthened by the often glorious afterglows. The fiercely brilliant streaks of red have disappeared; over the mountain ridge a flush of orange hovers, and softens the approaching blue. The western hills, that once stood out bronzed against the glare of light, are somber-hued. But suddenly, as by a fairy's wand, the roseate flush of beauty rises in the east, and stretches its beautiful tints all over the sky. As the sun sinks, but before it ceases to shine on our atmosphere, the temperature of the air begins to fall, and its cooling is accompanied by an increase in the size of the particles floating in it by the condensation of the water-vapor. The particles to the east lose the sun first, and are thus first cooled. Accordingly, the rays in that direction are best sifted by the larger water-clad particles of dust, and the roseate coloring is there more distinct than in the north and south. As the sun sinks further, the particles overhead become cooler, and attract the water-vapor; thus they increase in size, and thereby reflect the red rays. Here the red hues, at first visible in the east, slowly rise, pass overhead, and descend in the west to form the charming afterglow. Sometimes a flood of glory will roll once more along the summits of the hills, entrancing the attention of the artistic spectator.

All examinations of the volcanic dust lately collected from the atmosphere show that a great quantity of it is composed of small glassy crystals. An abundance of these would quite account for the peculiarity in the visibility of the first glow; and the evidence seems to indicate that the quantity of such crystals is sufficient to produce the result. When these are fully illuminated, they become in turn a source of illumination, and reflect their reddish light all around. In winter sunsets, the water-clad dust-particles become frozen, and the peculiarly brilliant crimson is seen, coloring the dead beech leaves and red sandstone houses, and making them appear to be painted with vermilion.

If, then, there were no fine dust-particles in the upper strata of the atmosphere, the sunset effect would be paler; if there were no large particles in the lower strata, the beautiful sunset effects would cease. In fact, if our atmosphere were perfectly void of dust-particles, the sun's light would simply pass through without being seen, and soon after the sun dipped below the horizon total darkness would ensue. The length of our twilight, therefore, depends on the amount of dust in one form or another in our atmosphere. Not only, then, would a dustless atmosphere have no clouds, but there would be no charming sunsets, and no thought-inspiring twilights.

There is a generally prevalent fallacy that the coloring at sunrise or sunset is much finer when seen from the summit of a

mountain than from a valley. To this matter Mr. Aitken has been giving some attention, and his observations point the very opposite way, corroborative of his dust-theory. From the summit of the Rigi Kulm in Switzerland he saw several sunsets, but was disappointed with the flatness and weakness of the coloring; whereas in the valley, on the same evenings, careful observers were enchanted with the gorgeous display. The lower dusty humid air was the chief source of the color in the sunset effects. His opinon is strengthened by the fact that when from the summit he saw large cumulous clouds, the near ones were always snowy white, while it was only the distant ones that were tarnished yellow, showing that the light came to these clouds unchanged, and it was only the air between the far-distant clouds and his eye that tarnished them yellow. On the mountain-top it required a great distance to give even a slight coloring. The larger and more numerous dust-particles in the air of the valley are, therefore, productive of more brilliant coloring in sunrise or sunset than the smaller and fewer particles on the mountain-top.

It is now admitted that the inherent hue of water is blueness. Even distilled water has been proved to be almost exactly of the same tint as a solution of Prussian blue. This is corroborated by the fact that the purer the water is in nature, the bluer is the hue. But though the selective absorption of the water determines its blueness, it is the dust-particles suspended in it which determine its brilliancy. If the water of the Mediterranean be taken from different places and examined by means of a concentrated beam of light, it is seen to hold in suspension millions of dust-particles of different kinds. To this fine dust it owes its beautiful, brilliant, and varied coloring. Where there are few particles there is little light reflected, and the color of the water is deep blue; but where there are many particles more light is reflected, and the color is chalky blue-green. Along its shores the Mediterranean washes the rocks and rubs off the minute solid particles, which make the water beautifully brilliant.

That this is the case can be illustrated. If a dark metal vessel be filled with a weak solution of Prussian blue, the water will appear quite dark and void of color. But if some fine white powder be thrown into the vessel, the water at once becomes of a brilliant blue color; if more powder be added, the brilliancy increases. This accounts for the changes of depth and brilliancy of color in the several shores of the Mediterranean. In Lake Como, where there is an entire absence of white dust-particles, the water is of a deep blue color, but void of brilliancy; but, where the lake enters the river Adda, the increase of the current rubs down fine reflecting particles from the rocks; in consequence, there the water is of a finer blue. When the dust-particles carried down

by the Rhône spread out into the center of the Lake of Geneva, the color assumes the deeper blue, rivaling in brilliancy any water in the world.

The phenomenon called a haze puzzled investigators until Mr. Aitken explained it on the principle of the condensing power of dust-particles Haze is only an arrested form of condensation of water-vapor. If one half of a dusty pane of glass be cleaned in cold weather, the clean part will remain undewed, while the dusty part is damp to the eye and greasy to the touch. Why is this ?

Fit up an open box with two pipes, one for taking in water and the other for taking away the overflow. Inside fix a thermometer. Cover the top edge of the box with India rubber, and fix down with spring catches (so as to make the box water-tight) a glass mirror, on which dust has been allowed to collect for some time. Clean the dust carefully off one half of the mirror, so that one half of the glass covering the box is clean and the other half dusty. Pour cold water through the pipe into the box, so as to lower the temperature of the mirror, and carefully observe when condensation begins on each of the halves, taking a note of the temperature. It will be found that the condensation of the water-vapor appears on the dust-particles before coming down to the natural dew-point temperature of the clean glass. The difference between the two temperatures indicates the temperature above the dew-point at which the dust condenses the water-vapor. Mr. Aitken found that the condensing power of the dust in the air of a smoking-room varied from 4° to 8° Fahr. above the dew-point, whenever that of the outer air varied from 3° to 5½°.

Moisture is, therefore, deposited on the dust-particles of the air which is not saturated, and condensation takes place while the air is comparatively dry, before the temperature is lowered to the dew-point. The clearest air, then, has some haze; and, as the humidity increases, the thickness of the air increases. In all haze the temperature is above the dew-point. And in all circumstances the haze can be accounted for by the condensing power of the dust-particles in the atmosphere at a higher temperature than that required for the formation of fogs, or mists, or rain.

But whence comes the dust ? Meteoric waste and volcanic *débris* have already been mentioned. On or near the sea the air is impregnated by the fine brine-dust lashed by the waves and broken upon the rocks and vessel-sides. But the most active of all substances as a fog-producer in towns is burned sulphur. No less than three hundred and fifty tons of the products of the combustion of sulphur from the coal are thrown into the atmosphere of London every winter day. But the powerful deodorizing and antiseptic properties of the sulphur assist in sanitation; and it is better to bear the inconvenience of fogs than be subjected to the

evils of a pestilence. At the same time it should be known that smoke-particles can be deposited by the agency of electricity. If an electric discharge be passed through a jar containing smoke, the dust will be deposited so as to make the air clear. Lightning clears the air, restoring the devitalized oxygen and depositing the dust on the ground. Might it not, then, be possible for strong enough electrical discharges from several large voltaic batteries to attack the smoke in the air of large cities, and especially the fumes from chemical works, so as to bring down the dust in the form of rain instead of leaving it in the form of mystifying fog?

Organic germs also float in the air. Some are being vomited into the air from the pestilential hot-beds of the lowest slums. In a filthy town no less than thirty millions of bacteria in a year will be deposited by the rain upon every square yard of surface. A man breathes thirty-six germs every minute in a close town, and double that in a close bedroom. The wonder is how people escape sickness, though most of these germs are not deadly. In a healthy man, however, the warm lung surfaces repel the colder dust-particles of all kinds, and the moisture evaporating from the surface of the air-tubes helps the prevention of the dust clinging to the surface.

From this outline the reader will observe the increasing importance of careful attention to the influence of dust in the economy of nature. As a sickness-bearer and a death-bearer it must be attacked and rendered harmless; as a source of beauty unrivaled we must rejoice at its existence. The clouds that shelter us from the sun's scorching heat, the refreshing showers that clear the air and cheer the soil, the brilliancy of the deep-blue sea and lake, the charms of twilight, and above all the glory of the colors of sunrise and sunset, are all dependent upon the existence of millions of dust-particles which are within the power of man's enumeration. No more brilliant achievement has been made in the field of meteorology than during the past few years by the careful observation and inventive genius of Mr. Aitken in connection with the importance of dust in air and water.—*Longman's Magazine.*

It appears, from the complete edition of the works of Huygens, now in course of publication at The Hague, that as soon as he had succeeded in applying the pendulum to the regulating of clocks, claims were set up for priority in the invention. The best-founded claims were those of Galileo, which were championed by Prince Leopold de' Medici. According to the formal statement drawn up by Viviani, Galileo had conceived the idea, but failed to make the application of it. He had a pendulum connected with wheel-work, but omitted to provide any weights, springs, or other means of keeping the machinery in motion.

SKETCH OF DIMITRI IVANOVICH MENDELEEF.

THE discovery of the periodic law in the atomic weights of the elements has furnished chemists with a new standard of accuracy and a new guide in research. While it must be regarded as Mendeleef's most conspicuous scientific achievement, the Russian chemist is the author of many other labors of hardly less real importance.

DIMITRI IVANOVICH MENDELEEF was born at Tobolsk, Siberia, February 7, 1834, the seventeenth and youngest child of Ivan Paulovich Mendeleef, director of the gymnasium there. Soon after his birth the father became blind and had to resign his position, leaving the care of the family upon the mother, a competent and energetic woman. She established and managed a glass-works, and brought up and educated her family upon its profits. Dimitri was sent to the gymnasium at Tobolsk, and, at sixteen years of age, to St. Petersburg, where he was to study chemistry in the university, under Zinin; but was transferred to the Pedagogical Institute in the same building with the university, where he entered the physico-mathematical department, or that of the natural sciences. He studied chemistry, physics, mathematics, botany, zoölogy, mineralogy, and astronomy, under teachers who were most of them also professors in the university. Having concluded his course here, he was appointed to the gymnasium at Simferopol, in the Crimea; then, during the Crimean War, to a gymnasium in Odessa; and in 1856 he became a *Privat Docent* in the University of St. Petersburg, where he had already received the degree of Master of Chemistry. In 1859, having obtained permission from the Government to travel, he became engaged at Heidelberg in the determination of the physical constants of chemical compounds. In 1863 he was made Professor of Chemistry at the Technological Institute of St. Petersburg, and in 1866 at the university, where he received the degree of Doctor of Chemistry.

Mendeleef had already, before his engagement as a *Privat Docent*, entered upon the career of research and publication in which he has so brilliantly distinguished himself. His first paper, on Isomorphism, was prepared while he was still in the Pedagogical Institute. He entered into the discussion of the relations between the specific gravities of substances and their molecular weights, and presented to the physico-mathematical faculty of the university a number of theses or problems relating to specific volumes; and as early as 1856 he accepted Gerhardt's mode of determining the chemical molecule. His researches on specific volumes were continued till 1870, and in them, according

to Prof. T. E. Thorpe, from whose memoir in Nature we derive most of the material of this sketch, he extends Kopp's generalizations, and traces the specific volumes of substances through various phases of chemical changes. In a paper on the thermal expansion of liquids above their boiling-points, he showed that the empirical expressions given by Kopp, Pierre, and others are equally applicable to much higher temperatures, and that the expansion-coefficient gradually increases with the diminution in molecular cohesion of the liquid, until, in the case of some liquids, it becomes even greater than that of the gas. In 1883 he contributed to the English Chemical Society a paper giving a simple general expression for the expansion of liquids under constant pressure between zero and their boiling-points—a formula analogous to that which expresses Gay-Lussac's law of the uniformity of expansion of gases; but which, like Gay-Lussac's law, however correct in theory, is subject to deviations in application. These deviations were shown to be related to the molecular weights of the gases.

Researches in thermal chemistry, made in 1882, showed him that the data obtained by Berthelot, Thomson, and others, regarding the "heats of formation" of hydrocarbons, stood in need of correction, because allowance had not been made for the physical changes involving absorption or evolution of heat which accompany the chemical changes considered; and he gave a table giving the heats of formation from marsh-gas, carbon monoxide, and carbon dioxide, of a series of hydrocarbons, for chemical reactions that actually occurred, while the reactions given by Berthelot and others were not realized in practice.

In the investigation of solutions, Mendeleef propounded in 1884 the law that in solutions of salts the densities increase with the molecular weights; but if we take, instead of the molecular weights, the weights of their equivalents or those of the equivalents of metals, the regularity of increase disappears; and, though his research was not yet finished, he submitted an equation as preliminary to ulterior results promising to give a more general formula. The results of the determination of the specific gravity of aqueous solutions of alcohol were applied, according to Prof. Thorpe's memoir, toward the elucidation of a theory of solution in which Dalton's doctrine of the atomic constitution of matter could be reconciled with modern views concerning dissociation and the dynamical equilibrium of molecules. "According to Mendeleef, solutions are to be regarded as strictly definite atomic chemical combinations at temperatures higher than their dissociation temperature; and, just as definite chemical substances may be either formed or decomposed at temperatures which are higher than those at which dissociation commences, so we may have the same phenomenon in solutions; at ordinary temperatures they

can be either formed or decomposed. In addition, the equilibrium between the quantity of the definite compound and of its products of dissociation is defined by the laws of chemical equilibrium, which require a relation between equal volumes and their dependence on the mass of the active component parts."

In 1881 Mendeleef turned his attention to experiments on the elasticity of the gases, which he continued with the aid of several of his pupils. They led to many interesting results, among which was one showing that the deviations from Marriotte's law were in opposite directions at pressures above and below that of the atmosphere; indicating that air, for instance, as well as carbonic acid and sulphurous acid gases, experience a change of compressibility at certain pressures.

The results of these experiments were used in studies of the physical nature of the rarefied air of the upper atmosphere and the application of aëronautics, and he attempted to organize meteorological observations in the upper atmosphere by means of balloons.

The principles on which Mendeleef based the periodic law were first explained in a paper read before the Russian Chemical Society in 1869. As repeated by the author in his Faraday lecture to the English Chemical Society, they declare that the elements, if arranged according to their atomic weights, exhibit a periodicity of properties; that elements which are similar in chemical properties have atomic weights that are nearly of the same value or which increase regularly; that the arrangement of the elements or groups of elements in the order of their atomic weights corresponds to their so-called valencies, and, to some extent, to their distinctive chemical properties; that the elements which are the most widely diffused have small atomic weights; that the magnitude of the atomic weight determines the character of the element, just as the magnitude of the molecule determines the character of a compound body; that the discovery of many yet unknown elements may be expected; that the calculation of the atomic weight of an element may sometimes be amended by a knowledge of those of its contiguous elements; and that certain characteristic properties of elements can be foretold from their atomic weights. The theory was founded upon experiment, and assumed the adoption of the definite numerical values of the atomic weights, and the recognition that the relations between the atomic weights of analogous elements were governed by some general law, with a more accurate knowledge of the relations and analogies of the rarer elements as necessary for the completing and proving of it. In accordance with the theory as thus developed, a table was composed by Mendeleef and Victor Meyer, including nearly but not quite all of the elements

—for there were a few of which not enough was yet accurately known to determine their subjection to the rule—arranged in the order of their atomic weights and in groups or periods showing their relations and analogies. These periods might be said to be self-constituted; for, without departing from the orderly arrangement which Mendeleef had declared to exist, they so fell in line as to exhibit the very likenesses and differences which he had insisted upon as a part of his theory. Arranging them in parallel columns, it appeared that th several members of each period were substances that showed no similarity or community of chemical properties with one another; but that the members of the different periods showed an unmistakable parallelism with the corresponding members of the previous period. The columns also exhibited a regular gradation of electro-chemical properties, the most electro-positive elements occupying the places at their heads, and the extreme electro-negative elements the bottom places. The results of later discoveries and more accurate determinations have all been to confirm the correctness of the tabulation and the periodic theory. Thus scandium, gallium, and germanium, when discovered and examined, were found to fit into vacant places in the table, and to possess the atomic weights and the properties which the authors had predicted should belong to the elements falling in those places; and Mendeleef was able to say, in his Faraday lecture, delivered twenty years after the first suggestion of his theory, "When, in 1871, I described to the Russian Chemical Society the properties, clearly defined by the periodic law, which such elements ought to possess, I never hoped to live to mention their discovery to the Chemical Society of Great Britain as a confirmation of the exactitude and the generality of the periodic law." Up to the time of the formulation of this law, Prof. Thorpe says in his article: "The determination of the atomic value or valency of an element was a purely empirical matter, with no apparent necessary relation to the atomic value of other elements. But to-day this value is as much a matter of *a priori* knowledge as is the very existence of the element or any one of its properties. Striking examples of the aid which the law affords in determining the substituting value of an element are presented in the cases of indium, cerium, yttrium, beryllium, scandium, and thorium. In certain of these cases, the particular value demanded by the law, and the change in representation of the molecular composition of the compounds of these elements, have been confirmed by all those experimental criteria on which chemists are accustomed to depend. . . . The law has, moreover, enabled many of the physical properties of the elements to be referred to the principle of periodicity. At the Moscow Congress of Russian Physicists, in Au-

gust, 1879, Mendeleef pointed out the relations which existed between the density and the atomic weights of the elements; these were subsequently more fully examined by Lothar Meyer, and are embodied in the well-known curve in his Modern Theories of Chemistry. Similar relations have been observed in certain other properties, such as ductility, fusibility, hardness, volatility, crystalline form, and thermal expansion; in the refraction equivalents of the elements, and in their conductivities for heat and electricity; in their magnetic properties and electrochemical behavior; in the heats of formation of their haloid compounds; and even in such properties as their elasticity, breaking stress, etc." While one may be readily inclined and many have been led to look for a connection between the periodic law and theories of the unitary origin of matter, Mendeleef has not allowed his studies in the subject to be embarrassed by any such prepossession. He said in his Faraday lecture: "The periodic law, based as it is on the solid and wholesome ground of experimental research, has been evolved independently of any conception as to the nature of the elements; it does not in the least originate in the idea of a unique matter; and it has no historical connection with that relic of the torments of classical thought, and therefore it affords no more indication of the unity of matter, or of the compound nature of the elements, than do the laws of Avogadro or Gerhardt, or the law of specific heats, or even the conclusions of spectrum analysis." The periodic law is developed in the author's Principles of Chemistry, which was first published in 1869, and appeared in a fourth edition, after a thorough revision, with many important additions and modifications, in 1882.

In a lecture before the Royal Institution in 1889, Mendeleef sought to apply a broader generalization and to discover a harmonious law regulating both chemical and astronomical phenomena. The immediate object of the lecture was to show that, starting from Newton's third law of motion, it is possible to preserve to chemistry all the advantages arising from structural teaching, without being obliged to build up molecules in solid and motionless figures, or to attempt to ascribe to atoms definite limited valencies, directions of cohesion, or affinities. He supposed that harmonious order reigns in the invisible and apparently chaotic motions of the universe, reaching from the stars to the minutest atoms, which is commonly mistaken for complete rest, but which is really a consequence of the conservation of dynamic equilibrium that was discovered by Newton, and has been traced by his successors as relative immobility in the midst of universal and active movement. The unseen world of chemical changes was regarded as analogous to the invisible world of the heavenly bodies, "since

our atoms form distinct portions of an invisible world, as planets, satellites, and comets form distinct portions of the astronomer's universe; our atoms may therefore be compared to the solar system, or to the systems of double or single stars. . . . Now that the indestructibility of the elements has been acknowledged, chemical changes can not be otherwise explained than as changes of motion, and the production by chemical reactions of galvanic currents, of light, of heat, or of steam-power, demonstrate visibly that the processes of chemical reaction are inevitably connected with enormous though unseen displacements, originating in the movements of atoms in molecules."

When, in 1880, the St. Petersburg Academy of Sciences refused, in the face of strongly signed recommendations, to elect Mendeleef a member in its Chemical Section, other scientific societies hastened to express their appreciation of him by making him an honorary member. Among these were the University of Moscow; the Russian Chemical and Physical Society, which presented him an address where it spoke of him as "a chemist who has no equal among Russian chemists"; the University of Kiev, the Society of Hygiene, etc. From England he received the Davy medal of the Royal Society in 1882, and the Faraday medal of the Chemical Society in 1889.

Prof. Mendeleef is the author of a treatise on Organic Chemistry which was a standard work in its time, and which, according to Prof. Thorpe, exercised a great influence in spreading abroad the conceptions which are associated with the development of modern chemistry. In 1863 he published a cyclopædia of chemical technology—the first really important work of the kind produced in Russia. He has frequently been commissioned to report on the progress of chemical industry as illustrated at the various international exhibitions. His investigations and reports on petroleum have been an important factor in the developing of the trade at Baku, and in removing the monopoly which formerly dominated the market there.

We quote again, in concluding, from Prof. Thorpe: "No man in Russia," he says, "has exercised a greater or more lasting influence on the development of physical science than Mendeleef. His mode of work and of thought is so absolutely his own, the manner of his teaching and lecturing is so entirely original, and the success of the great generalization with which his name and fame are bound up is so strikingly complete, that to the outer world of Europe and America he has become to Russia what Berzelius was to Sweden, or Liebig to Germany, or Dumas to France."

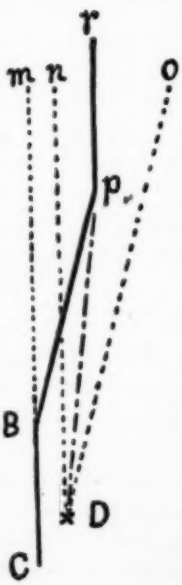
CORRESPONDENCE.

RIGHTING THE BICYCLE.

Editor Popular Science Monthly:

SIR: The article What keeps the Bicycler Upright? in the Monthly for last April was a very interesting one, especially to wheelmen, but I think it needs a little supplementary statement to make it complete. Mr. Charles B. Warring, the author, states that the rider's lost equilibrium is restored by bringing his point of support under him, and gives the impression that this point can be moved square to the right or left, like the foot of Mr. Warring's A-frame, saying nothing about the forward movement of the wheel. While agreeing with the main part of this statement, I think the righting of a bicycle can be more clearly and accurately explained as follows:

It is one of the elementary laws of physics that the center of gravity of a body must be over some point in its base in order that the body may stand without outside support. Now, the base on which a bicycle rests is only a line about half an inch wide, which joins the point B, in my figure, where the front wheel rests on the ground, with the point C, where the rear wheel rests. (I adopt Mr. Warring's lettering.) So long as a vertical line dropped from the center of gravity of the machine falls on some point of the line B C, the bicycle is in stable equilibrium; but, when it falls outside this narrow base, as at the point D, the equilibrium becomes unstable. In order to keep the machine and rider from coming to the ground, D must be brought upon B C; or, what is equivalent, B C must be brought under D. The latter is what is actually done. As the rider can not slide his machine sideways over the ground, he steers it obliquely toward the side on which he tends to fall. Thus, if the bicycle were running in the direction *C m*, he turns it toward the right so as to go in the direction *B p*. The center of gravity of the machine and its rider, which had been moving parallel to the course of the machine, is now acted on by two forces: (1) its acquired momentum, which tends to carry it on in the direction *D n*, and (2) the force constantly being received from the moving bicycle, which tends to carry it along the line *D o*, parallel to the new course of the machine. The result is, that it takes an intermediate direction, *D p*, in accordance with the law of the composition of forces. Thus, by being made to follow converging lines, D and B C are brought together at the point *p*. As quick as this is accomplished the bicycle must be turned again parallel to its original direction, or D will pass over to the left of B C and make the machine tilt toward that side. Hence, it is seen that righting a falling bicycle in motion involves two movements: first, a turn of the machine toward the side on which it tends to fall, then a return to its original course. Gravity was not mentioned among the forces considered above, but its action does not vitiate my explanation. I will add that I ride a bicycle myself, and so am acquainted with this matter on the practical as well as on the theoretical side.



Very truly yours,

FREDERIK A. FERNALD,
L. A. W., 12,996, N. Y. Division.

[Substantially the same explanation as that given above has also been received from Mr. Thomas Cary Welch, of Buffalo, N. Y.—EDITOR.]

THE KELLEY'S ISLAND GROOVE.

Editor Popular Science Monthly:

DEAR SIR: In this month's number of the Science Monthly, under the "Miscellaneous" head, you have a notice of the work now in progress for the preservation of the great glacial groove on Kelley's Island.

In that notice you speak of Prof. Wright and Dr. Sprecher as having "surveyed" the plot of land on which the groove is located. In this statement you are in error. They are *not* surveyors, and they did not survey the plot, and the suggestion of such an occupation for them must seem to those who know them very inappropriate. Prof. Wright is Professor of "New Testament Greek" at Oberlin, and the author of that noble book, The Ice Age in North America, published by the Appletons in 1890; and Dr. Sprecher is pastor of one of the largest Presbyterian churches in our city. And in that notice you make another error, which to me seems very absurd. You give my name as Young*blood*. It is not Young*blood*, as you may learn from your subscription list, where it has been recorded from the time that the first number of the Science Monthly was issued.

The facts are just these: my invitation to Prof. Wright and Dr. Sprecher to visit the island with me was wholly a matter of courtesy. While there I consulted them as to the best method of protecting the groove from the incursions of the Vandal curiosity-hunters, and also as to the best form of conveying the title, to be held in perpetuity for the benefit of science; and all of the surveying that was done by those gentlemen they did with their eyes, as they stood admiring that beautiful and wonderful work of Nature's laws.

I take pleasure in saying that I have completed the work of uncovering fifty feet of the groove, leaving fifty feet still covered to the depth of about twelve feet with clay, gravel, and fragments of the lime rock, just as it was left by Nature's laws when their work was finished, and the tools with which that work was done—granite bowlders—lie scattered over the island, and on the mainland, as far west as the Indiana line, there to rest, imperishable and unchanged, until Nature shall again take them up to do its work.

Were you to see that groove at this time I feel sure that you would pronounce it to be the most beautiful and wonderful evidence of the glacial movement that has ever been brought to the notice of civilized man.

On the 237th page of Prof. Wright's Ice Age there is an engraving which gives an imperfect view of the easterly end of the great groove, as it appeared before it was uncovered. And on the 238th page of the same book there is an engraving of another grooved rock, which is a little north of the great groove, from which I had taken off about a hundred feet before the photograph was taken, and sent to various scientific institutions. This, too, you will see is a most perfect and beautiful specimen of Nature's work.

I beg that you will pardon me for troubling you with this letter, for I feel that it is due to my friends and also to myself that the errors which I have noted should be corrected.

And, now that I have nothing further to say on the subject which prompted this letter, I will add a few words regarding The Popular Science Monthly. I have been a subscriber from the time of the issue of the first number, and I now have thirty volumes bound; and I take pleasure in saying that I think that there are no other thirty volumes to be found which contain such a vast and varied amount of useful information, or which are so well calculated to educate men in matters which advance our civilization, as those.

And more—they are a most noble monument to "Edward L. Youmans," more beautiful and enduring than marble or granite.

I am, sir, very respectfully yours,

M. C. YOUNGLOVE.

CLEVELAND, *September* 16, 1891.

[The paragraph noticed by Mr. Younglove was compiled from a slip which was sent to the Monthly from a Cleveland paper. The language of the slip was followed, without supposing that the word "surveyed" was meant to be used in a technical sense, but rather perhaps in its original sense of looked-over, or perhaps as meaning that Drs. Wright and Sprecher had the ground surveyed. The change of our correspondent's name to Youngblood was one that we much regret; but it was also one that might naturally occur in transcription or type-setting and be overlooked by a stranger to the person concerned; for to a stranger no suggestion of error would be likely to occur.]

EDITOR'S TABLE.

THE STRONG MAN.

FORTY years ago or less the apostle of the hour was Carlyle, the fashionable gospel was the gospel of force, and the hope of the world was supposed to lie in the advent of certain heroes, strong, resolute men, who were to heal our social and other diseases by the prescriptions of a benevolent despotism. The gospel of force and all its accompanying ideas have somewhat fallen into discredit to-day. These latter times have proved very unfavorable to strong men, or at least to those who have tried to pose in that character. Louis Napoleon was a strong man: he greatly dared on a certain 2d of December just forty years ago, and for a time he seemed to be a living justification of Carlylism; but the sage of Chelsea lived to see the Man of Destiny cast down from his high pre-eminence and every vestige of his rule obliterated by an indignant people. Bismarck was a strong man, full of an almost reckless courage and utterly impatient of criticism and opposition; yet how sudden and complete was his fall! Thiers wished to play the part of the strong man in France, and so did Marshal Mc-

Mahon after him; but the country put both of them aside and passed on to policies of which they disapproved. Later Boulanger pranced across the scene in the assumed character of a savior of society; but as soon as the firm hand of lawful authority was laid on him he slunk into exile and dwindled into insignificance; finally, wrecked alike in character and estate, he sought death at his own hand. Balmaceda was another would-be strong man, and he too fills a suicide's grave. Lastly, we have Parnell, a man whose courage was indomitable, whose fortitude could not be shaken, who by the sheer force of his personality baffled the plans and confused the policies of the ablest statesmen of Great Britain; yet who, trusting to his strength to win him a personal triumph after he had violated the essential conditions of successful struggle, ended his career in failure and disgrace.

Evidently there is something wrong with the gospel of force. Heaven sends the strong men in fairly liberal supply, men who are quite prepared to fill the Carlylean requirements in the matter of doing and daring, despising small scruples and trampling on rights; but their success is short-lived, and their failure points a moral which is hardly to be found in the Carlylean philosophy. That moral is that, while strength is a good thing in itself, and courage and resolution are virtues, they need to be guided by knowledge and a careful study of conditions, if they are not to rush on to disaster. Nay, more, we see that individual strength is only weakness unless it vibrates in unison with the greater strength of true principles of action, the strength that resides in the play of great social forces. No man to-day can win any great triumph except by being in the right, and this is the great political lesson which we should strive to impress on the rising generation. To be sure, there are many false lights—mostly, however, of a minor kind—shining in the world and alluring men to a career of selfish adventure. There are men who have climbed to business or political success by means that will not bear criticism. But the examples afforded by those who have tried such means to their own ruin are more striking and impressive, if not more numerous, than any that can be quoted on the other side.

Hero-worship is well if it simply means sincere admiration for noble qualities; but it is misleading in the highest degree if it causes us to trust for great results to the action of this or that masterful individuality. To-day the "common sense of most" is the most potent factor in all social and political progress, and no man is wise who does not bear this in mind. There is ample scope still for the exercise of the highest moral and intellectual qualities, and the true hero may yet win the admiration and gratitude of society; only, what is required is that he should know the structure and laws of the society in which he lives, and seek rather to give the best expression to the tendencies of the time than to impose his own individuality on his contemporaries. Only he who, in a profound sense, obeys possesses the secret of rule.

The times are favorable, we think, for the presentation of new political ideals. Strong men of the old type, iron-handed warriors, and stern legislators, are out of date; on the other hand, the want of firmness and principle in connection with political affairs was never more conspicuous. We want a new race of strong men in whom the gamester element shall be wholly absent, and who shall aim to accomplish their ends not by personal *tours de force*, nor yet by craft and flattery, but by steady adherence to principle, and patient efforts to awaken the public to a sense of their true interests. The strong man of the future will be strong in knowledge and in social sympathy; and his strength will be spent, not in efforts to perpetuate his personal ascendency, but in efforts to develop all

that is best in the society of the time. The true strong man as we conceive him will have no greed for power; his greed, if such it may be called, will be for usefulness; and he will show his strength by his willingness to retire at any moment from a public to a private position rather than prove unfaithful to his convictions or do anything unworthy of a man of honor. Strictly speaking, a man who with adequate knowledge and intelligence tries faithfully to serve the public can never be obscure, though offices should not seek him nor caucuses make mention of his name. The public at large will recognize and honor his efforts, and his influence may be greater in a private station than that of a score of average legislators. We do not, however, look to our educational institutions to do much to develop this new type of citizen; we trust rather to general educative influences that are abroad in the world. We trust, we may say, in a considerable degree to such writings as those of Mr. Spencer, instinct as they are with noble views of liberty and of justice, and conveying at the same time clear and enlightened ideas regarding the nature and functions of the state. It is possible that private associations for the purpose of causing more intelligent views of citizenship and its duties to prevail might accomplish very good work; and we hope that something may be attempted in this way in connection with the University Extension movement which is now making so satisfactory progress. We certainly do not at this moment know of any more useful work in which an intelligent man could engage, than this of introducing a scientific element, however feeble at first, into the chaotic welter of our State and national politics.

POLITICAL JUSTICE.

It is singular what difficulty many intelligent persons experience in entertaining the idea that in a democracy there can be political injustice. "What possible means can you suggest," we are often asked, "of deciding political questions save the vote of the majority? And what ground can any one have to complain so long as he exercises the franchise with the rest? The minority can not expect to rule, can it?" These questions all proceed upon the assumption that there can not be a moral element in any political question; whereas, in point of fact, there is a moral element in every political question. If two partners were trying to arrange the terms of a separation, and each in the most shameless manner were to set at naught all considerations of equity, and strive only to get the largest possible amount out of the business for himself, we should scarcely approve of the proceeding. Every one feels that equity has something to say in such a matter. If any property whatever had to be divided, and if, instead of bringing considerations of right to bear, the parties were at once to plunge into a squabble with no guiding principle whatever save individual greed, we should think as meanly of their intelligence as of their honesty. We all feel instinctively that wherever moral principle *can* furnish a guide it *should* furnish a guide—in other words, that to decide any question without reference to moral grounds which admits of being settled on moral grounds is a gross offense against both morality and common sense. Supposing, then, that some one who had banded himself with others to carry by force a decision involving injustice to a minority—say of stockholders—should impudently say, "We had the votes and we used them"—our only conclusion would be that he was a hardy and cynical villain. Things of this kind have sometimes been done; but for the most part vice has at least paid to virtue the tribute of hypocrisy.

To bring this home to the question before us, the nation is a great corporation and the citizens are shareholders. A general election is a meeting of the

shareholders. There is an opportunity for honest and well-meaning citizens to consult and act for the benefit of the great national corporation. There is also an opportunity for others to plot and plan for their private benefit, to be secured at the cost and to the injury of the corporation. A combination may be formed to elect a corrupt directorate or executive with the expectation that it will be the submissive creature of those who invested it with power. Some will be prepared to imperil the very existence of the nation in order that they may carry certain selfish purposes of their own into effect. Thus every general election and, indeed, every phase of political action affords an opportunity for the practice of political justice or of political injustice; and to say that any particular determination of the electors or of a legislative body is just because it commanded a majority of votes is as absurd as to say that in a physical encounter right must rest with the conqueror.

"What are you going to do about it," say some, "if the people manifest a complete indifference to these considerations?" We can do nothing about it, we reply, but uphold the true principle, and trust that the apparent "foolishness of preaching" may in the end prove wiser than the wisdom of our practical politicians who wield votes precisely as they might wield clubs. It is all a question of the moral growth of the people; and we can not but hope that the time will come when even the average citizen will understand that right is not *made* by majorities, but that majorities are happy when they are able to discover what right is, and pay it the homage of their support.

TRAMP COLONIES.

THERE appears to be an epidemic of schemes for reforming shiftless people by wholesale. The latest reported is a proposal by a Mr. Heller, of Newark, N. J., to establish seven colonies, in as many States, for the benefit of old and unemployed people and tramps. The chief feature of the scheme is to be the reformation of tramps. Work is to be provided for those who will work, and Mr. Heller evidently expects that a large part of them will. He doubtless actually believes what the tramps say of themselves, and accepts the familiar "can't get work" whine for absolute truth. This belief is squarely contradicted by well-known facts. Plenty of work can be had now, without any colony machinery, by those who will work. During the past summer workers have been called for all over the United States, to gather in this year's bountiful harvest. No tramp could extend his travels to twenty miles outside any large city without coming across farmers who would be glad to give him fifteen or twenty dollars a month and board for faithful work. In a recent book on Crime and its Causes, the author, William Douglas Morrison, who is an English prison official, puts the number of vagrants who are willing to work at not much over two per cent. To confirm his view he quotes the following striking testimony from M. Monod of the Ministry of the Interior in France:

> According to M. Monod, a benevolently disposed French citizen wished to know the amount of truth contained in the complaints of sturdy beggars that they were willing to work if they could get anything to do or any one to employ them. This gentleman entered into negotiations with some merchants and manufacturers, and induced them to offer work at the rate of four francs [eighty cents] a day to every person presenting himself furnished with a letter of recommendation from him. In eight months seven hundred and twenty-seven sturdy beggars came under his notice, all complaining that they had no work. Each of them was asked to come the following day to receive a letter which would enable him to get employment at four francs a day in an industrial establishment. More than one half (four hundred and fifteen) never came for the letter; a good many others (one hundred and thirty-eight) returned for the letter but never presented it. Others who did present their letter worked half a day, demanded two francs,

and were seen no more. A few worked a whole day and then disappeared. In short, out of the whole seven hundred and twenty-seven, only eighteen were found at work at the end of the third day. As a result of this experiment M. Monod concludes that not more than one able-bodied beggar in forty is inclined to work even if he is offered a fair remuneration for his services.

The idea of forming a community with such material for its citizens is absurd in the extreme. The tramp will not work so long as he can find soft hearted and softer headed people who will give him a subsistence in idleness. These self-satisfied charitable persons, who give indiscriminately to save themselves the trouble of helping judiciously, really entice more unfortunates into beggary than they raise out of it.

LITERARY NOTICES.

EVOLUTION IN SCIENCE AND ART. Lectures and Discussions before the Brooklyn Ethical Association. New York: D. Appleton & Co.

THE topics considered in these lectures include not only the special unfolding of each branch of science, but also sketches of the leading evolutionists and outlines of their methods. The first of the series is a concise and excellent review of *A. R. Wallace* and his work, by Prof. E. D. Cope. The co-author with Darwin of the theory of natural selection is honored as a biologist, not for researches in anatomy or paleontology, but for his mastery of hexicology—the study of the mutual relations of living objects. Extensive travel for twelve years in the tropics furnished him with a storehouse of zoölogical facts. From these resulted various papers on birds' nests, protective coloration, and mimicry; while the theory of natural selection was drawn from his observation of the variations of species. Besides his works on evolution, he has written books of travel and essays on political economy. Prof. Cope regards Dr. Wallace as a fine example of his own doctrine, that all force is will-force, and pays another tribute to him as typical of the intelligent spirit of this century, determined to know and to use the knowledge for the benefit of mankind. His explanation of force and intelligence, as caused by an influx of spirit, is deemed, however, "an unnecessary interjection in an otherwise continuous operation of known and unknown causes."

As Dr. Wallace is so stanch a supporter of the theory that variations are congenital and environment a secondary feature, while Prof. Cope holds as firmly to the opposite view, several mooted points are discussed *en passant*, and in conclusion a synopsis is given of the respective tenets of the Neo-Lamarckian and Neo-Darwinian schools.

The famous zoölogist and author of monism, Prof. *Ernst Haeckel*, is the theme of the second lecture, by Thaddeus B. Wakeman. The life and enthusiastic labors of the great naturalist are fascinating subjects. Whether studying at "dear Jena," or diving in the Indian Ocean, or waging war with Prof. Virchow, his zest for knowledge is unappeasable and magnetizes his followers. His wonderful industry has given to the world nearly a dozen valuable zoölogical works and several charming books of travel. It is his philosophy or religion, however, that especially attracts his biographer. Mr. Wakeman is consumed by a monistic fervor; and it is questionable whether, in his anxiety to rid the universe of "spooks," he does not create some for iconoclastic purposes. The "unknowable" of Herbert Spencer, or Prof. Huxley's limitations of knowledge, need some endowment of objectivity before they can be properly exorcised as wraiths.

The Scientific Method is expounded by Dr. Francis E. Abbot in the third lecture. This, when tersely stated, consists of observation, hypothesis, and verification. A confirmed transcendentalist might oppose the first step by questioning whether one could observe an external world. So the lecturer gives an imaginary controversy between the realist and consistent idealist, and finally drives the latter logically into the corner of solipsism, where he is made to declare that the universe is within himself. The actual idealist always escapes this fate by allowing an inference of the objective which we can not know *per se*. As the idealistic individual shut up with himself can not know, so he can not add to human knowledge. The

scientific man, on the other hand, recognizes an external world and positive knowledge, and seeks to contribute some new grain of truth if he may. He observes, hypothesizes, and verifies, and finally submits his result to verification by the race, the ultimate criterion being *the unanimous consensus of the competent.*

Notwithstanding Dr. Abbot's clear statement of the scientific method, this final standard of knowledge seems ambiguous. The truth of a theory needs no further test than its complete verification by *all* the facts to which it applies.

To make a synopsis of the *Synthetic Philosophy* of Herbert Spencer intelligible within the limits of a lecture is a difficult task, which Mr. B. F. Underwood has accomplished extremely well. Not only this, but he has given an introductory analysis of the opposing philosophical systems which preceded the evolution hypothesis. The sensation philosophy of Locke and Hume, and the *a priori* speculations of Kant, representing hoary antagonisms of thought, were by Spencer's insight found to be different halves of the whole truth that knowledge is derived from experience, but the experience of the race furnishes innate ideas to the individual. Spencer's doctrine that we perceive only phenomena, and from these infer the noumenal existence which causes changes in consciousness, is known as transfigured realism; and, though charged with idealistic leaning by rank realists, is no more transcendental than the views of Dr. Maudsley and Prof. Huxley. According to the latter, "all phenomena are, in their ultimate analysis, known to us only as facts of consciousness." But it is the "unknowable reality" which proves a stumbling-block to many. Theologians dislike this, since it excludes a knowledge of God, and the scientific are afraid of it because Unknowable is printed with a capital, which suggests another sort of deity. Disciples of Haeckel vainly impute dualism to Mr. Spencer, while he declares, "I recognize no forces within the organism or without the organism but the variously conditional modes of the universal immanent force." Whatever chiseling time may effect in the body of Spencer's doctrine, there is good reason to believe with Mr. Underwood that the leading principles will remain intact.

In the *Evolution of Chemistry*, Dr. R. G. Eccles has skillfully traced the growth of chemical knowledge from the vague theories of the ancients to the definite, complex science of to-day. After the time of Aristotle the elemental theory or doctrine of abstract qualities saturated thought for fifteen hundred years. The scales first used by the young Scotch chemist Black weighed scholastic dogma as well as fixed air, and proved the hollowness of *a priori* reasoning. This step in verification made progress possible. Oxygen was discovered by Priestley, combustion explained by Lavoisier, and the law of definite and multiple proportions ascertained by Dalton. The idea of continuous matter was displaced by the atomic theory, and Avogadro's law regarding the volume of gases confirmed the hypothesis. The laws of specific heat, crystallography, and Mendelejeff's formula, each added its proof of atomic weight. The study of the coherence of groups of atoms resulted in the wonderful synthetic productions of the laboratory. The brilliant dyes, flavorings, perfumes, and medicines made by the chemist excelled those offered by Nature, and utilized hitherto waste products. Although the detail of organic chemistry is now beyond the mastery of any man, the outlook is infinite, and problems whose solution promises the secret of creation itself tempt the student. The composition of the ferments, pepsin and trypsin, or of the albuminoids, and the conversion of starch into cane sugar, would unlock incalculable benefits. The author considers the development of chemical knowledge, like the habits of atoms, closely illustrative of evolutionary law.

Thales suggested electricity as a condition of life, and the author of *The Evolution of Electric and Magnetic Physics* is inclined to agree with him. According to Mr. Kennelly, "it is possible, if it is not at present demonstrated, that electricity may be the active principle in the processes of animal vitality; . . . the relation between electricity and vitality may be so close as to amount to identity." This is perhaps pardonable in the chief electrician of Edison's laboratory, but it is doubtful if any eminent physiologist or psychologist will allow that nerve-fibers do more than artificially

resemble insulated wires, or that a dynamo can confer any degree of immortality. The growth of electric knowledge is recent; for twenty-two hundred years it was dormant. The seventeenth century witnessed investigation of electrical phenomena and of the properties of magnets, but for two centuries thereafter no connection was realized between them. It was only after Oersted's discovery, in 1820, that a magnetic needle is deflected by the electric current, that electro-magnetism became a science. Its subsequent progress was correspondingly rapid, and its offspring are the crowning inventions of to-day. Three propositions are especially emphasized by Mr. Kennelly: 1. All electricity tends to flow in closed curves or circuits. 2. The conductivity of the surrounding ether. 3. The production of light by electro-magnetic vibration.

The development of botany and the brilliant progress of electricity are as unlike as a flower and an electric spark. In his lecture upon the *Evolution of Botany*, Mr. Wulling shows that the accumulation of botanic knowledge was nearly as gradual as vegetable growth. The primitive needs were food and clothing, and an acquaintance with plants supplied these. Herbs were also found to be noxious or healing, and skill in remedies was sought and venerated in the early ages. In time so many species were described that various attempts were made to classify them, and at length the natural system of Jussieu prevailed. Investigation of the structure and anatomy of plants followed the introduction of the microscope. The establishment of botanical gardens facilitated the study of foreign flora; plant morphology and physiology were differentiated as branches of research; and, finally, geological, paleontological, and pathological botany constituted separate departments of this complex science. Mr. Wulling refers to the labors of many American botanists, and applies the formula of evolution to an analysis of botanical history.

Each of the foregoing lectures is preceded by a list of collateral readings useful to the student, and followed by a brief discussion of the subject by members of the Ethical Association.

THE NATURAL HISTORY OF MAN, AND THE RISE AND PROGRESS OF PHILOSOPHY. By ALEXANDER KINMONT. Philadelphia: J. B. Lippincott Company. Pp. 335. Price, $1.

THIS book comprises a series of lectures that were delivered and first published fifty years ago, or before the present methods of investigation were instituted, and before the existing theories of development had begun to prevail. Yet it is not antiquated, and the claim of the editor is supported that "the rapid movement of the world in all departments of thought, the changes of opinion and sentiment in doctrinal theology, and in philosophy, have not distanced nor superseded the ideas herein presented." The author regards the study of anthropology as chiefly valuable as an introduction to the science of Deity, and tries whether he can not trace in man, "the image and likeness" of God, "some of the more majestic elements of the original." He does not attempt any formal science of human nature, or any theory which might deserve the name of anthropology, "for such theory or perfect science, I imagine, would be premature still, by many hundreds of centuries." Yet, while he approaches the subject from a wholly different point of view than that from which contemporary philosophers regard it, and considers a different side of it, his thoughts lead him in the same direction as they take, and his work presents many foreshadowings of the doctrine of evolution. He might be described as a theological anthropologist. In the lecture on the origin and use of language he says that "the arguments drawn from the sacred scriptures, to establish a system of uniform sounds and modifications of voice to designate ideas, are of a kin with the systems of astronomy and geology drawn from the same book; all of which, after being fanatically maintained for a time by arguments supported by passion rather than philosophy, are compelled by degrees to give place to the solid truths of observation and experience." Not that anything in science militates against the authority of the scriptures; "but these books do not purport to deliver to us a system of science, but only to reveal the Author of Creation, and the established series of its epochs." Thus in the accounts of events, as in that of the creation, the statements are to be interpreted, not in the literal,

physical sense, but as condensed, emphatic utterances of the theological truth—in this case of God the Creator—which in the mind of the author predominates over the scientific truth. The labors of modern geologists do not affect the truths, before announced, in regard to the creation of the world, for the simple reason that they refer not to the workman, but to the physical characters of the work. "This distinction now begins to be understood, and will be so more and more, as the truths of religion and the truths of science are seen to be of different orders, sometimes apparently blended, but never actually confounded. . . . Three thousand years ago or upward, Theology in the Eastern world stood unconfounded with science, and men heard from her, and were satisfied with the response; that 'in the beginning God created the heaven and the earth'—that 'God said, Let there be light, and there was light'; and they heard the number of the days of creation also, and were satisfied; and similarly, in our times, it may be affirmed that Science stands on her own ground, unoccupied by theology, and expounds facts and establishes conclusions, no longer fearing or being feared; and men are now, in regard to science, what they used to be in regard to religion—free and unembarrassed, serving but one master. And this is the more worthy of observation when we recollect the history of the intervening period—how science has been confounded with religion, and religion with science, to the detriment and dishonor of both. . . . It is only when each pursues that order and series of truths which are peculiar to each that any mutual benefit can arise; but, when they encroach on each other's provinces, the most baleful effects ensue." The presentation of this branch of the subject, and the chapters on The Origin and Perpetuation of the Natural Races of Mankind, and Unity in Variety of the Human Race, are followed by studies of certain particular nationalities.

AN INTRODUCTION TO NATURAL PHILOSOPHY. By DENISON OLMSTED, LL. D. Fourth revised edition, by SAMUEL SHELDON, Ph. D. New York: The Baker & Taylor Company. Pp. 465. Price, $2.75.

IT is nearly half a century since Olmsted's Philosophy was first published, and although the progress of modern knowledge in this period has made four revisions necessary, the name and plan of the author are still deemed worthy of being retained. For the present revision the whole book has been carefully gone over, the chief efforts of the editor being spent in rewriting the parts treating of Electricity and Magnetism. The subjects Force, Energy, Work, Wave-motions, Organ-pipes, Spectrum Analysis, and Interference of Light-waves have also been almost entirely rewritten. Extended description of apparatus has been avoided. A few striking experiments have been described, but the choice of demonstration has been left largely to the instructor. Many new drawings, chiefly in outline, have been made. The work is adapted to college students. It would be improved by the addition of an alphabetical index.

The *Chapters on Electricity*, written by Prof. *Samuel Sheldon* for the above treatise, are also published separately (Baker & Taylor Company, $1.25). This volume is intended for use in those colleges which devote but thirty or forty hours to the subject, and the principles presented in it are those which the author thinks every liberally educated person should know. It has been the desire of the author to present each part of the subject in its most modern dress. This desire, however, has been tempered by a consideration of the intended functions of the book.

CHEMISTRY OF THE CARBON COMPOUNDS, OR ORGANIC CHEMISTRY. By VICTOR VON RICHTER. Authorized translation by EDGAR F. SMITH. Second American from the sixth German edition. Philadelphia: P. Blakiston, Son & Co. Pp. 1040. Price, $3.

THIS work is sufficiently detailed to meet the wants of advanced students of organic chemistry, and to serve as a reference-book for practical chemists. The present edition differs considerably in its arrangement and size from the first edition. The introduction contains added matter upon analysis, the determination of molecular weights, recent theories on chemical structure, electric conductivity, etc. The section devoted to the carbohydrates has been entirely rewritten, and presents the most recent views in regard to their constitution. The sections relating to the trimethylene, tetramethylene, and penta-

methylene series, the furfurane, pyrrol, and thiophene derivatives, have been greatly enlarged, while subsequent chapters, devoted to the discussion of the aromatic compounds, are quite exhaustive in their treatment of special and important groups. The translator has had the hearty co-operation of the author in preparing this edition.

TOPICS OF THE TIMES. By Rev. HOWARD MACQUEARY, Author of The Evolution of Man and Christianity. New York: United States Book Co. Pp. 238+51.

IN this book the Rev. Howard MacQueary shows that he is interested in and capable of discussing other than theological questions, for here he addresses himself to the vital questions of the times, in which a larger public will be interested than even the large one which has read his former book. This work is divided into two parts, the former consisting of Lectures on the Conflict between Labor and Capital; An Exposition of Nationalism; Truths and Errors of Henry George's Views; The Savages of Civilization; Popular Ideas of Poverty; Reduction of Hours of Labor; The Negro in America; The Bible in the Public Schools. The second part contains ten sermons, many of them on most important and interesting topics: Our Country: its Character and Destiny; The Sabbath Question; Criticism of the Bible; Did the Fish swallow Jonah? What's the Use of Praying? What is the Evidence of Life after Death? The God-filled Man; Unshaken Beliefs; Should we have Creeds? The Real Rights of Woman.

In his preface Mr. MacQueary defends the pulpit for undertaking the discussion of Topics of the Times. There are, he says, two radically different ideas of the Church and the pulpit. Some regard the clergyman as a sort of religious policeman whose duty it is to hold up before sinners pictures of hell to scare them into doing their duty. Others, however, hold that the Church and the pulpit have to do with the moral aspect of every question, political, social, or scientific, and that Religion and Morality are twin sisters. This latter point of view is justified by the example of the prophets of Israel, who denounced the social and political evils of their time. With regard to the papers in the book, the author says that they "are intended to be popular discussions of the great problems considered," but not to be "exhaustive or original." He has evidently succeeded in "casting the material in his own mold," as he claims to have done.

The reader of these papers will find them very interesting, stimulating to thought, and helpful to all to whom the burning questions of the day are serious problems. The author has brought to his task wide reading, an earnest consideration of the subjects treated, and an easy and agreeable style. The views of Henry George receive a pretty thorough treatment, and the paper on the Savages of Civilization is of thrilling interest.

There has been added to the lectures and sermons a paper on ecclesiastical liberty, which is the able defense of Mr. MacQueary before the ecclesiastical court of the Episcopal Church of the Northern District of Ohio against the charges of heresy. This paper is of permanent interest, although the case has now at length been definitely settled by Mr. MacQueary's withdrawal from the Episcopal Church.

THE RIGHT HAND; LEFT-HANDEDNESS. By Sir DANIEL WILSON. London and New York: Macmillan & Co. Pp. 215. Price, $1.25.

THIS treatise includes data originally accumulated in a series of papers communicated to scientific institutions in Canada, in which the author sought to determine the cause of left-handedness by a review of its history in its archæological, philological, and physiological aspects. To these, results of later investigation have been added; and besides the effort to trace left-handedness to its true source, the folly of persistently trying to repress an innate faculty of exceptional attitude, and the advantages to be derived from the systematic cultivation of dexterity in both hands, are insisted upon. In the former chapters of the book—on "the educated hand," "the willing hand," "palæolithic dexterity," etc.—the prevalence of right-handedness is shown to have been marked from the earliest and even the prehistoric ages of mankind. Its manifestation in children appears by the weight of evidence to be often spontaneous. The structure of primitive implements, ancient weapons, etc., shows it to have been the rule through the historical period. Philological arguments, references in ancient literature to right-handed-

ness, and to left-handed exceptions, the writing of ancient documents, and the positions of the figures in drawings, bear in the same direction. Consideration of these evidences precludes the idea of the origin of right-handedness lying in any ancient custom, or of its development and enforcement by education into a nearly universal habit. The conclusion is therefore inevitably forced on the inquirer that the bias in which this law originates must be traceable to some specialty of organic structure. This argument becomes stronger when we reflect that right or left handedness is not limited to the hand, but partially affects the lower limbs, as may be seen in foot-ball, skating, the training of opera-dancers, etc., so that eminent anatomists and physiologists have affirmed the existence of a greater development throughout the whole right side of the body. Theories have been proposed assuming stronger circulation, visceral predominance, or more vigorous muscular growth on the right side, but they do not seem to go to the root of the matter; while the theory of cerebral localizations on which many other human faculties have been found to depend seems more ample. It is understood that each hemisphere of the brain affects the opposite side of the body. In the majority of cases where the hemispheres have been weighed separately, the left hemisphere has been found heaviest. This would give predominance to the right side In the case of a single left-handed patient, Dr. Wilson and an associated physician found the right hemisphere to weigh the most. "No comprehensive indications can be based on a single case, but its confirmatory value is unmistakable at this stage of the inquiry; and thus far it sustains the conditions previously arrived at."

LABORATORY PRACTICE. A Series of Experiments on the Fundamental Principles of Chemistry. By JOSIAH PARSONS COOKE, LL. D. New York: D. Appleton & Co. Pp. 193. Price, $1.

TEACHERS who are striving against many obstacles to teach science according to its own proper method will be glad of the help which the senior Professor of Chemistry in Harvard College offers them through this volume. It is a manual of directions for experiments in which especial care is taken that what the experiments teach shall not be lost sight of. "The student should be given to understand clearly," says Prof. Cooke in his introduction, "that experiments performed mechanically, without intelligence, or carelessly recorded, are worth absolutely nothing, and should be so estimated in any system of school or college credits." This book is designed as a companion to The New Chemistry, by the same author, which contains no experiments for the student, as the present volume contains no extended statement of chemical principles. The principle that each experiment illustrates, however, is indicated by a heading, and in many cases the conclusions that the teacher should enforce are explicitly stated. Notes, questions, and problems are also inserted after each experiment or group of experiments, in order to direct the student's attention upon the essential features of the investigation in hand. Ample cautions accompany all experiments that would be dangerous if carelessly performed. The present issue of this manual has the value of a revised edition, for the book is an enlargement of a list of experiments printed in pamphlet form that has been used for several years in Harvard College and in a number of fitting schools. In order to make the expense less of an obstacle to the performance of these experiments by school classes, the author has sought to adapt to the purposes of instruction common household utensils, such as may be made by a tinsmith or found at any house-furnishing store. Two figures of a kerosene stove applied to laboratory purposes are given, and many other definite suggestions in regard to apparatus are furnished.

By the publication of Part IV, Dr. *Michael Foster*, F. R. S., has completed the fifth edition of his *Text-book of Physiology* (Macmillan, $1.90). This part comprises the conclusion of Book III, on the Central Nervous System and its Instruments, and Book IV, on the Tissues and Mechanisms of Reproduction. There is also an Appendix on The Chemical Basis of the Animal Body. In the portion of Book III here presented the special senses and the voice are briefly treated, and the account of reproduction is also brief. A little more than two hundred pages are given to the topics here enumerated, bringing the whole

number of the pages in the work up to 1,356. The author hopes to begin the publication of a sixth and carefully revised edition of the whole book early in the autumn. We would suggest that he add an index to the forthcoming edition.

Muter's Manual of Analytical Chemistry, several previous editions of which we have noticed, now appears, revised by an American editor, Dr. *Claude C. Hamilton*. This revision is based on the fourth English edition. The editor has made only such changes as were required to adapt the book to the United States Pharmacopœia except in the chapter on urine analysis, which has been enlarged, and to which cuts of microscopic sediments and other illustrations have been added. The chapter on water analysis has been altered to correspond with Wanklyn's methods, as those are most generally used in America. Several other processes have been added, such as estimation of chloral hydrate, of fat in milk, etc., and various minor changes in arrangement have been made in the interest of convenience in using the treatise.

A volume of *Elementary Lessons in Heat, Light, and Sound* has been prepared by Prof. *D. E. Jones* (Macmillan, 70 cents). It is an experimental book, intended for beginners, and aims to bring out "one of the chief advantages of science as an educational subject—the training in the habit of observation, and of learning from things at first hand." In the methods of reasoning, as well as in the choice of words and subject-matter, the author has endeavored to be as simple and clear as possible. He has also repeatedly tried and modified each experiment so as to present it in a simple form, and avoid the more usual causes of failure. The book is illustrated.

Part III of the *Short Course of Experiments in Physical Measurements*, by *Harold Whiting* (D. C. Heath & Co., $1.20), deals with principles and methods. About half of its three hundred pages are devoted to some fifty tables, and notes on their arrangement and use. This material is preceded by ten chapters, in some of which such matters as Observation and Error, and Reduction of Results are treated, while the others deal respectively with the several departments of physics.

A pamphlet is before us entitled *The Universe and its Evolution*, being a translated abridgment of a five-volume work in Hebrew, by *S. J. Silberstein*. The author denies the law of gravitation, and asserts that Kepler's laws not only are not explained by it, but furnish evidence against it. He brings forward many arguments to show that the planets could not have been projected from the sun into their present orbits. He maintains, further, that they could not continue their revolutions indefinitely, for the attraction of the sun would draw them in upon that body, unless, as he affirms, motion begets motion. In another chapter some of Spinoza's ideas of God are combated, and the author then unfolds his conception of the universe. He considers the source of all to be the Absolute Intellect, whose offspring, the absolute essence, brought the atoms into existence, and the atoms are controlled by a force that he calls "centrality." This force resides in the center of every body, and maintains the character of the body. Several other physical laws are laid down, and the larger work is referred to for a full statement in regard to them. The author apparently has not considered the modern nebular theory.

The revision of *The Chemical Analysis of Iron* (Lippincott, $4) that has just been made by the author, *Andrew A. Blair*, has consisted in the correction of mistakes that were apparent in the first edition, and the adding of matter called for by the advance in analytical chemistry during the past three years. The Table of Atomic Weights has been revised, and the Table of Factors has been changed to correspond to the new values.

A report on *The Pediculi and Mallophaga affecting Man and the Lower Animals*, by Prof. *Herbert Osborn*, has been issued as a bulletin of the Department of Agriculture. It describes the various kinds of lice found on man, the monkey, dog, goat, ox, hog, horse, the rodents, poultry, and various other animals, giving illustrations of forty-three species.

A pamphlet made up of *Original Communications of the Zymotechnic Institute* has been published by the director, Mr. *J. E. Siebel* (242 Burling Street, Chicago). The papers are reports of scientific investigations into a variety of matters connected with the brewing industry, such as the composition of the

acrospire of barley, yield of material in the brewery, differentiation of subterranean water-supplies, etc. There are six plates, showing different kinds of bacteria, of saccharomyces, molds, and starch, microscopic aquatic life, and forced beer sediments.

An *Address on the University Extension Movement*, delivered by *Richard G. Moulton*, A. M., has been published by the American Society for the Extension of University Teaching (1602 Chestnut Street, Philadelphia). Mr. Moulton defines university extension as "university education for the whole nation organized upon itinerant lines." He says that university education differs from school education in being unlimited, and that a university fails miserably in its duty if it does not give one those tastes and those mental habits which will lead him to go on learning to the end of his days. Not every person will get the same thing out of university instruction. Each helps himself according to his own capacity. The extension teaching involves lectures, class-work, printed syllabuses, weekly written exercises, examinations, and certificates. The interest that has been aroused in England is shown by the written exercises voluntarily sent in, changes in the character of the demands on the public libraries and of the conversation at social gatherings, traceable to courses of lectures, and similar indications. Mr. Moulton speaks of university extension as a missionary movement, and urges all who possess the benefits of culture to assist in giving culture to others.

The Iowa State Medical Society has begun the publication of a bimonthly magazine, *The Vis Medicatrix*, which will serve as the journal of the society (Des Moines, $1 a year). It is edited by *Woods Hutchinson*, M. D., and the first number contains the proceedings at the society's fortieth annual session, the president's address, departments devoted to diseases of animals, plant diseases, medical colleges, notes and news, etc.

Mr. *John A. Wright*, of Philadelphia, has published a pamphlet on *The Practical Working and Results of the Inter-State Commerce Act*, the purpose of which is to present (1) the law of distribution of the returns on all products that require transportation to a market; (2) the policy of transporters in view of their duties as common carriers; (3) the difficulty of estimating the cost of transportation; (4) a measure on which a just rate of profit on the stock of transportation companies may be based. The author points out provisions in the law which he holds should be expunged as impracticable and dangerous.

A treatise on *The Principles of Agriculture* has been prepared for common schools by Mr. *I. O. Winslow*, and is published by the American Book Company. It regards a knowledge of the subject as identical with a knowledge of the natural laws and principles that underlie rural life and rural pursuits, and considers it an important element in the education of the young. Hence it begins at the foundation with descriptions of the substances of the earth, accounts of its geological history, and the leading facts and principles of the several sciences that bear directly on agriculture and rural life. The applications of the principles are then described in the chapters on Plants, Fertilizers, Cultivation, and Animals. Minor and subordinate topics are omitted, in the belief that a thorough knowledge of the few main points is worth more to the pupil than a confused idea of the whole. Points not definitely settled are avoided, or mentioned only briefly. The book is designed, primarily, for use in the public schools, and contains no difficulties too great for ordinary pupils of twelve or fourteen years.

A text-book on the *Elements of Civil Government*, published by the American Book Company, has been prepared by *Alex. L. Peterman* for use in schools, and as a manual of reference for teachers. It is intended to supply what is a serious want in many of our schools, which omit instruction concerning civil government and the science of citizenship. It begins with the family, the first form of government with which the child comes in contact. As his acquaintance with rightful authority increases, the school, the civil district, the township, the county, the State, and the United States are taken up in their order. In each case the nature and purposes of the Government are explained, and its scope and methods. The author endeavors to present the subject in a simple and attractive way.

In a curious book entitled *Beyond the Bourn* (Fords, Howard & Hulbert), Mr. *Amos*

K. Fiske records a dream of the future world, and expounds his views on the destiny of man. The fiction is sustained of a person who was rendered insensible and to all appearances dead for three days by a railroad accident, and whose spirit sojourned in the other world for that time. Recalled to life and earth, he feels himself a stranger among those who were of his kind, and is impelled to leave a record of his experiences and impressions in the abode of spirits. Hints are given of the persistence of the principle of evolution throughout the universe, and of the continued development and perfection of the human race in the after-life.

A collection of the Rev. Henry Ward Beecher's patriotic addresses, compiled a few years ago by Mr. *John R. Howard*, contained a review of Mr. Beecher's Personality and Influence in Public Affairs. This is now separated from the original volume by the author, and published by itself, by Fords, Howard & Hulbert, under the title of *Henry Ward Beecher: a Study of his Personality, Career, and Influence in Public Affairs*. It is, in fact, an interesting and critical biography of a man whose influence on American thought and political tendencies has been second to that of few if any others. The book is embellished with excellent portraits of Mr. Beecher at forty-three, at sixty-five, and at seventy-three.

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Bardeen, C. W. The Tax-payer and the Township System. Pp. 15.—The Teacher as he should be. Pp. 15. Syracuse, N. Y.

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POPULAR MISCELLANY.

Association of Official Geologists.—The preliminary steps were taken at Washington during the meetings of the International Geological Congress toward the formation of an official organization of the directors of State and national geological surveys. The more important objects of the projected society are the determination of the proper objects of public geologic work, the improvement and unification of methods, the establishment of the proper relative spheres and functions of national and State surveys, co-operation in works of common interest and the prevention of duplication of work, the elevation of the standard of public geologic work and the sustenance of an appreciation of its value, and the inauguration of surveys by States not having any now, which co-operate with the other State surveys and with the national survey.

Changes in Level of the Atlantic Coast.—The fluctuations in height of the Atlantic lowland coast-lands of the United States were described by Prof. W J McGee in a paper read before the American Association. In the Pleistocene period the land stood between three hundred and eight hundred feet below its present level. Immediately afterward the land rose to from three hundred to six hundred feet above its present height, and the shores of the Atlantic and the Gulf retreated to from one hundred to five hundred miles beyond their present position. Afterward the land gradually sank, and the waters readvanced until the geography was much the same as to-day. Then came another incursion of the ocean and gulf, bringing sea-waters over nearly all the area upon which Washington is built, and over considerable portions of the North and the South. During this period there was deposited a series of loams and brick-clay and bowlder-beds, upon which Washington is located, and which has been named, from the District, the Columbia formation. At the close of the Columbia period the land again rose one hundred or two hundred feet higher than at present, and river channels were cut from fifty to seventy-five miles beyond the present coast-line. It then began to sink, and this movement is yet in progress.

South American Railroads.—Three of the railroads that start from the Pacific coast of South America and run up the valleys of the Andes, says President Gardner G. Hubbard, in his address to the National Geographic Society, are among the most remarkable roads in the world, ascend to a greater elevation than any others, and reach a height which in Europe and the United States would be above the snow-level. They were intended to reach the gold and silver mines between the Andes and Cordilleras. The first, called the Oroya or Central Railroad, one hundred and eleven miles long, starts from Callao and crosses the Andes at an elevation of nearly fifteen thousand feet. It is intended to extend it to the navigable waters of the Amazon. Three hundred miles southward of this, the second road runs from Mollendo, Peru, by Arequipa to Puno or Lake Titicaca, and thence northward on the plateau four hundred and seven miles to San Rosas, on the route to Cuzco. For a part of the way it runs through a country so destitute of water that the only supply for the engines and stations is by an iron pipe eight inches in diameter and fifty miles long, running from an elevation of seven thousand feet to the sea-coast. Seven or eight hundred miles south of Mollendo a line runs from Valparaiso, in Chili, to Buenos Ayres, eight hundred and seventy miles. It crosses the Andes through a tunnel two miles long, at an elevation of ten thousand five hundred and sixty-eight feet above the sea; after leaving the mountains it runs over the pampas two hundred miles, without a curve or a grade more than three feet above or below the plain, and will soon be completed from ocean to ocean. From Rio Janeiro several roads have been constructed over the mountains west of that city to different parts of Brazil. There are now from six thousand to seven thousand miles of road in operation in the Argentine Republic, five thousand or six thousand in Brazil, and three thousand or four thousand miles in the other states, making a total of about fifteen thousand miles of railroad in operation. The apparently most feasible route for the proposed Pan-American Railroad to run from the Caribbean Sea to the Argentine Republic, and to connect with the others, starts from Cartagena, follows the valley of

the Magdalena River eight hundred miles to Dividal, seventeen hundred feet above the sea; crosses the eastern Cordilleras at an elevation of about six thousand five hundred feet to the head-waters of the Caqueta or Yapura, a branch of the Amazon, and runs down that river three hundred and seventy-five miles to the mouth of the Engarros, five hundred and fifty feet above tide-water. From the Caqueta River the route passes through Ecuador to Iquitos, Peru, crossing fourteen tributaries of the Amazon. From Iquitos it ascends the Amazon and the Ucayle five hundred miles to Napal, thence continues across the Montaña, and the numerous valleys of the Amazon about six hundred miles, to Santa Cruz in Bolivia, or twenty-four hundred miles from Cartagena; while a branch will run up the Apurimac to Cuzco. This road would run for two thousand miles along the foot-hills of the Cordilleras, in which is probably the richest mining region in the world, and would greatly facilitate the opening and working of the mines. It would cross many branches of the Amazon, and thus connect with fifty thousand miles of navigable waters, at least nine thousand of which are above Iquitos; and it is claimed that the business from twenty thousand miles of navigable waters would find by this route a nearer outlet to Europe and American markets than by Pará. There is every variety of climate on the route; and the country, under a wise government, is capable of sustaining an immense population and giving abundant support to a railroad.

Purification of Sewage.—The method of purifying sewage at Worcester, Mass., by chemical precipitation was described by Prof. L. P. Kinnicutt at the meeting of the American Association. The sewage treated contains a notably large quantity of the waste products of various manufacturing establishments, and an unusually large amount of free acids and iron salts. The Carpenter process is employed for purification. By adding lime and the crude sulphate of aluminum the suspended matter is all removed and the total organic matter is reduced over two thirds. The effluent water is clear and colorless, without odor, and with only a slight alkaline taste, and can cause no nuisance when run into a stream of not more than five times its volume. The precipitate, or sludge, is free from bad odor, and when dried contains nearly sixty per cent of iron oxide, ten per cent of carbon, thirteen per cent of nitrogen, and four per cent of phosphoric acid. Its theoretical value is about forty-five dollars per ton. If no use is found for it, it can be disposed of by burning.

Evolution of Clocks and Watches.—The beginning of modern clock-making may be dated from 1656, when Huygens attached the pendulum to the clock. This gave horology a place in the exact sciences such as it had not before held. The next important advance was the invention of the watch balance-spring, by Dr. Robert Hooke, of the Isle of Wight. He was the author of other valuable inventions and improvements, among them the "anchor" escapement and some ingenious tools for the making of astronomical instruments. Previous to 1691 watches had only the hour-hand. Daniel Quare, of London, added the minute-hand. Nine years later the horizontal escapement in its perfect state was made public by George Graham, F. R. S., and the device of jeweling the parts most subject to wear was introduced into England by M. Facio, of Geneva. The English Government commission on a method of finding the longitude, of which Sir Isaac Newton was a member, appointed in 1714, published the conclusion that an accurate time-keeper would furnish the best means; and an offer was made by the Government for the discovery of a method—fixed at £10,000, if by it the longitude could be defined to one degree; £15,000, if within two thirds of a degree; and £20,000, if within half a degree. John Harrison, born at Foulby, near Pontefract, in Yorkshire, in 1693, who devised the gridiron compensation pendulum, was stimulated by the offer to efforts to find a similar regulator for a watch, and devised an automatic regulator which Halley thought might prove to be of some value. He applied it to a time-keeper, which, having stood a test in a boat on the Humber, was successfully taken to Lisbon. The Board of Longitude advanced him £500. A second instrument was not satisfactory to the board; but a third won for the inventor the gold medal of the Royal Society. This instrument was sent on a long voyage to Jamaica. After

being eighteen days out, a difference of more than two degrees appeared between its indications and the shipmen's calculations. Harrison insisted that his time-piece was right, and told the shipmen that, if they turned in a certain direction, they would sight a certain island the next morning—if the maps were right. They did so, and the island was seen, according to his prediction. Like results were obtained as island after island was passed. On arriving at Port Royal, after a voyage of two months, the time-keeper was five seconds slow; and on returning to England, after five months, its error was less than a minute and a quarter. Harrison was not allowed the offered reward till more sure tests were made, but was given £5,000. The watch was tested on a second voyage, with triple precautions, and Harrison was allowed £5,000 more, and promised the rest of the £20,000 when he had taught others how to make the instruments. Having fulfilled all possible conditions, he was fully paid in 1767. His time-keepers are still preserved, in charge of the astronomers royal, in Greenwich Observatory.

Egyptian Identifications.—Dr. Edouard Naville, to whom the world owes the recovery of the cities of Bubastis and Pithom, in Egypt, gave a summary of the results of his work in excavating other cities of Egypt before a meeting of the Victoria Institute in June. His explanations related principally to places connected with the Exodus. He had found that Succoth, whither the children of Israel journeyed from Rameses, was not a city, as some had supposed, but a district. An inscription discovered at Pithom left it no longer doubtful that that place was the ancient Heroopolis, whence, according to Strabo, Pliny, and other authors, merchant ships sailed to the Arabian Gulf. This fact coincided with the results of modern scientific surveys, which showed that there had been a gradual rising of the land, and that the Red Sea once extended up to the walls of Pithom. The identification of Baal Zephon had been aided by some papyri, which proved that it was not a village or a city, but an ancient shrine of Baal and a noted place of pilgrimage. Other places were Migdol and Pi Hahiroth, in the identification of which the author had again been aided by a papyrus, and it seemed probable that the Serapeum was the Egyptian Maktal or Migdol. It was greatly to be regretted that a bilingual tablet discovered there a few years ago had been destroyed before being deciphered.

Forest Reproduction in New England.—The question whether our forests are disappearing is answered in one way by Mr. I. H. Hoskins, of Newport, Vt., who says, in Garden and Forest: "In northern New England they certainly are not. The farmer has a constant struggle against the persistent spread of seedling trees over his cleared land; and if man should abandon this region I think in a hundred years it would hardly be possible for a visitor to realize that it had ever been inhabited by civilized man. It is this constant back-pressure of the forest upon intruding settlements that prevents the average farmer from taking an interest in forestry. He has to fight for his life against the forest, and the idea that the forests are likely to be extirpated seems to him quite absurd. One of the largest and finest sugar orchards in this town was seventy years ago a wheat-field." While this is true of some regions, Garden and Forest remarks, there are other vast areas that will never reforest themselves; and the new forests are of inferior quality to the old ones which they succeed.

Astronomy and Numismatics.—A curious suggestion is made by Dr. A. Vercoutre, of a way in which astronomical knowledge may be made of service to numismatical science. Stars and members of the solar system often figure on antique medals, notably on coins of the Roman republic, and they sometimes appear as heraldic allusions to the magistrate by whom the coin was struck. Thus, on a coin of L. Lucretius Trio, 74 B. C., the seven stars in Ursa Major —called by the Romans Septem Triones— appear in evident phonetic allusion to the name, Trio, of the magistrate. On a coin struck in B. C. 43, Dr. Vercoutre noticed five stars, one of which was much larger and more brilliant than the others. As the constellation Taurus contains the only group of five stars, with one much the brightest recognized by the ancients, the

author attributed the coin to P. Clodius Turrinus, who used the name Taurus or Taurinus as a phonetic equivalent of his own. A coin struck by Marius Aquillus, B. C. 94, has figured on it the first four stars of the constellation Aquila. They are shown in nearly the same relative positions they now occupy, and therefore contain the earliest known representation of a part of the celestial vault.

Native Jade in Europe.—From the occurrence of articles of jade in ancient graves in Europe and America, while the only known quarries of that mineral were in Asia, archæologists have concluded that all the materials used by the prehistoric artisans must have had an Oriental origin. Prof. F. W. Rudler has shown that this conclusion is no longer necessary. Within the last few years Herr Traube, of Breslau, has discovered nephrite, or true jade, in places near Jordansmühl and near Reichenstein, in Silesia. Pebbles of nephrite have also been recently recorded by Dr. Berwerth from the valleys of two rivers in Styria. A pebble believed to be of jadeite has been found by M. Damour at Ouchy, on the Lake of Geneva, and the same mineral has been recorded from Monte Viso, in Piedmont. Dr. G. M. Dawson has recorded the discovery of small bowlders of jade, partially worked, in the lower part of the Frazer River Valley,; and Lieutenant Stoney has obtained the mineral in place at the Jade Mountains, in Alaska, 150 miles above the mouth of the river Kowak. The present aspect of the jade question is, therefore, different from that which it presented when the late Prof. Fischer and others favored the view that the jade implements of America and Europe were of exotic origin. It seems now probable that in both continents the material of the implements is indigenous.

Causes of Baldness. — The probable causes of baldness are summed up by Dr. Joseph Tyson as, in their order, insufficient exposure of the hair; influence of heredity; excessive mental work and great anxiety; venereal and alcoholic excesses; and constant washing and want of pomade. Preventive treatment is advised. Children should, as much as possible, do without caps, and their hats, when worn, should be of the lightest description. A stouter hat may be necessary during the hot season, for the prevention of sunstroke. Head-coverings should not be warn indoors, in trains, or in closed carriages. Straw hats are preferable in summer and in still weather; in winter, hats made of light felt, well ventilated and unlined. The ordinary tall hat, or stove-pipe, and the thick, heavy, unventilated top hat, can not be too strongly condemned. The second cause does not admit of practical treatment, while the course to be pursued with the third and fourth causes is obviously one of avoidance. Too constant washing of the hair is unnecessary as well as harmful. Once a week is enough for cleanliness and for maintaining the strength of the hair. Excessive brushing, especially with hard brushes, should be avoided. The author advises the application of some form of simple grease or oil, after the hair has been washed; and, when the head hair is becoming rapidly thinned, some stimulating material, such as ammonia and cantharides, applied to the oil, will increase its good effects.

The Mesopotamian Desert.—The Mesopotamian Desert, according to Dr. D. Moritz, comprises two thirds of the southern part of the country, forming an unbroken plain with little or no vegetation, except in the depressions where rain-water collects or the inundations penetrate. Piles of ruins, or *débris*—which the inhabitants designate by a name signifying "signs"—rise from these perfectly level plains from the height of a few yards to a hundred feet, and are sometimes several miles in diameter. Some of the walls and buildings still tower aloft, and, in more recent ruins, lines of streets can yet be traced; the dams of ancient canals are still visible, and are sometimes fifty feet high. The atmosphere is murky, so that the highest hills are obscured at a distance of a few miles. Dust-storms, for which abundant material is furnished by the old crumbled walls of brick, fill the air at times so that the sun is obscured; and in time they have changed the appearance of the country by blocking up the ancient canals and forming long, parallel lines.

They now threaten to cover up the few existing fields on the Tigris. While extensive tracts in these regions have been lost to cultivation from the lack of water, another part is suffering from its superabundance, and the land is swamp at the normal level of the streams. Such is now what was once the most populous region of the earth.

Tests of Woods.—A system of tests of woods was described by Prof. Fernow at the meeting of the American Association, which have been undertaken at the Department of Agriculture for the determination of the relation of technical and physical qualities to each other and to conditions of growth. The method includes the selection of test-material from as many essentially different soil and climatic conditions as the species may occupy; the examination of the structure and physical condition of the material down to the minutest detail; the usual testing with special care; and the compilation and comparative discussion of the results of the tests in connection with the physical examination and the known conditions of growth. Besides more reliable data than have been hitherto obtained of the qualities of our principal timbers, the investigation promises to furnish us with a knowledge of the conditions under which desirable qualities can be produced by the forest-grower.

Phosphorus in Plants and Animals.—In a paper presented to the American Association meeting in 1890, Mr. Walter Maxwell showed that a vegetable organism, during the initial stages of growth and under the action of the ferments operating in germination, possesses the power of taking the phosphorus present in seeds or in soils as mineral phosphates, separating the phosphorus from the inorganic combination, and causing it to appear in the young plantlet in an organic form as a lecithine. In a second part of his paper, which was read at the association meeting of 1891, the author showed that the lecithine bodies present in the animal kingdom revert to the mineral form under the action of the ferments present in the animal organism. The phosphorus contained in a hen's egg, with which the investigations were conducted—both in the forms of mineral phosphates and of organic phosphorus compounds as lecithines—was first determined. Next, eggs were incubated, and the products of incubation were studied. It was found that the phosphorus contained in the natural egg as a lecithine reappeared in the incubation product as calcium phosphate, forming the bone of the chicken. It thus appears from the investigations that the lecithine bodies are a medium through which phosphorus conducts its circulation between the mineral, vegetable, and animal kingdoms —passing from the mineral, through the vegetable, into the animal kingdom, where it reappears as a mineral compound.

Carpet-weaving in Persia.—Few ancient carpets are to be found in Persia now, the stock having been gathered up by European travelers, merchants, and curio hunters. It may seem almost incredible to many people that among the ancient carpets so many are still in good condition and comparatively little worn. The secret of this is, according to M. G. de Vries, that not only has great care been bestowed on the weaving of the carpets and on the quality of wool used, but because of the custom prevailing in the houses of Eastern people. While we enter our own and other people's rooms with the same boots with which we walk through the muddy streets, a Persian never enters any room without leaving his boots or shoes at the door. The most important present manufacture of carpets is carried on at Sultanabad. The weaving is done exclusively by women. The only share the men take in the work is, that to them the merchants give out the designs, the colors, and the money required for the weaving. The loom is an inexpensive and simple structure, consisting of four wooden poles, which generally occupy the whole length of the weaving-room. When weaving is going on regularly, three or four women work at a carpet of fairly large size, the weaver's wife being, as a rule, the principal weaver, and at the same time superintending the work of her daughters or hired women. The rule is, that, at each end of the board on which the women are seated, there shall be one female overseer. For carpets of very large size, in the weaving of which seven or eight women are employed, there is also an overseer in the middle. At the age of seven years girls begin to assist in the

weaving; previous to that age they spend a year or so on the board watching the other women so that they may get accustomed to the work. If a young woman who has been brought up to the loom gets married, the first thing she does is to try and obtain an order for a carpet, so that the weaving of carpets passes from one generation to another. Every stitch in the carpet is made separately, and it is afterward clipped with the scissors and beaten down. In a good carpet there are about ten thousand stitches to every square foot. The clipping must be done every time with equal care, otherwise when the carpet is finished the pile will be short in some places and longer in others. Upon the beating down depends the closeness of the texture; the more a weaver beats her stitches down, the finer, of course, the carpet is. She knows how many stitches she has to weave to every quarter of a Persian yard; but she generally makes less, in order to save wool, time, and trouble. The designs are the individual property of the weavers, and are protected by law. The shades of color are a matter of importance, and attention is paid to having them in harmony with the varying tastes of the European markets. Besides woolen carpets, rugs are exported, woven entirely of silk. The weaving of such rugs is done in the same way as the weaving of carpets, but the labor is far greater in proportion, as they are always of a very fine make. Such rugs can be used as table or sofa covers, portières, etc., but, as they are made of pure silk, they are very costly.

Holy Stones of the East and the West.—A curious paper was read by Mr. Charles G. Leland at the International Congress of Orientalists concerning the salagrama stone of India and the salagrana of the Toscana Romana, as a curious link connecting the East and West. The Indian salagrama is a kind of ammonite, the size of an orange, and having a hole in it. According to the legend, Vishnu the Preserver, when pursued by the Destroyer, was changed by Maya into the stone, through the hole of which the Destroyer as a worm wound his way. The Italian salagrana is a stalagmite, which is believed by the people, on account of its resemblance to the little mounds thrown up by earthworms, to be such a mound petrified. They carry it in a red bag, along with certain magical herbs, and pronounce over it an incantation to the effect that the irregularities and cavities in it have the property of bewildering the evil eye and depriving it of its power. The author was informed by believers in such things that anything like grains, irregular and confused surfaces, interlaced serpents, or intricate works, blunted the evil eye. Interlaced cords are sold in Florence as charms. Even the convolvulus is grown in gardens against the evil eye. In the Norse mythology, Odin as a worm bored his head through a stone in order to get at "the mead of poetry." Hence all stones with holes in them are known as Odin stones, also as "holy stones," and are much used at the North as amulets. Hung at the head of the bed, they are supposed to drive away nightmare. Possibly there is a connection with the salagrana here. So interlacings in decoration may be originally designed to avert the evil eye and bad luck. A recent traveler in Persia was told that the patterns on carpets in that country were made intricate so that the evil eye might be bewildered. In the salagrana of Italy the number of grains or protuberances must be counted one by one before the witch can do evil. In the Arabian Nights the ghoul Amina must eat her rice grain by grain; and in South Carolina the negroes protect a person who is bedridden or nightmared by strewing rice round his bed, which the witch, when she comes, must count grain by grain before she can touch her victim.

Two Ancient Races.—Describing, in the International Oriental Congress, his excavation of the pyramid of Medum—the tomb of King Senefru, of the third Egyptian dynasty, and the oldest known building in the world—Mr. H. Flinders Petrie spoke of the entire skeletons which had been obtained of men of that remote period (some 4000 years B. C.) as providing an anatomical study of importance for ethnology. The peculiar mode of interment of most of these persons shows that a religious difference then existed. The bodies of the highest class or race were interred, extended at full length, with vases of pottery or stone, and head-rests; while the greater number of the bodies were interred

contracted, with the knees drawn up to the breast, even when the chamber was long enough to hold them extended; and they were not mummified No pottery was interred with them, except one or two rough vases in one tomb. This treatment was not due to neglect, for the deceased were always placed with great care and regularity, with the head to the north, the face to the east, and the body lying on the left side. Such essential differences in the mode of interment, and the provision for the deceased, point to a difference of race. The contracted interment may have pertained to one of the prehistoric races, and the extended interment with provision of vases, etc., to the dynastic race. The skeletons were well preserved, but tender and friable; the bones lay in their places, and the linen cloth wrapped around the body was intact. Rheumatic disease and other maladies of the bones were already well known at that period.

Non-drinking Sheep and Cows.—The facility with which animals can adapt themselves to altered conditions of existence is illustrated by Dr. A. J. Crespi in an article in the Gentleman's Magazine on Curiosities of Eating and Drinking. He quotes from Miss Betham Edwards's account of her excursions in the barren, stony, wilderness-like region of the Causses of France the description of some of the interesting facts which it affords to evolutionists. "The aridity, the absolutely waterless condition of the Larzac has evolved a race of non-drinking animals. The sheep, browzing the fragrant herbs of these plateaus, have altogether unlearned the habit of drinking, whilst the cows drink very little. The much-esteemed Roquefort cheese is made from ewe's milk—that of the non-drinking ewes of the Larzac. Is the peculiar flavor of the cheese due to this non-drinking habit?"

NOTES.

Mr. H. A. Hazen maintained in the American Association that the opinion that tornadoes whirl is a mistaken one. Of the two ways of learning the shape of tornadoes, that of observing them directly is burdened with difficulties, and is neither satisfactory nor accurate; while the study of them by observation of their *débris* is easy, and will lead to correct conclusions. Reports of such observations of between two hundred and three hundred tornadoes have been received at the Weather Bureau during the past two years, and the evidence from them is overwhelmingly favor of the view that there is no whirl.

A description of the methods pursued in the Geological Survey of the United States was given, with graphic illustrations, by Major Powell to the International Geological Congress. The speaker explained that, inasmuch as the Survey is a national institution, supported by taxes paid by the public, the results of its work are made intelligible to the people, and are not prepared so as to be understood only by men of science.

The Committee on Forestry in the American Association reported that, under a recent law authorizing the President to withdraw from sale or other disposal such public timber-lands as he may deem fit, the boundaries of Yellowstone Park had been enlarged. A necessary enlargement of the Yosemite Valley reservation was anticipated, and a number of other reservations in Minnesota, Montana, Idaho, Colorado, and California, comprising several million acres, would be asked for in a memorial prepared by the American Forestry Association.

The next meeting of the International Geological Congress will be held in Berne, Switzerland, in 1894. The Geological Survey of Russia, supported by the Czar, invites the Congress to hold its meeting in 1897 in St. Petersburg.

According to a paper by G. L. Spencer and E. E. Ewell, in the American Association, wheat flour and bran mixed with molasses seem to be the favorite materials for the manufacture of imitation coffees. It is hardly probable that the manufacturer selects a good quality of flour, for a bad or damaged article would be cheaper. Refuse crackers and other waste of bakeries probably supply a portion of the material employed. A factory recently seized in France employed a mixture containing 500 grammes of ferrous sulphate, 15 kilogrammes of chicory, and 35 kilogrammes of flour. With the exception of such mixtures as this, imitation coffee is not detrimental to health, but especially affects the purse of the purchaser.

A curious feature of old-time life is recalled in Mr. Freshfield's paper before the British Society of Antiquaries on the wrought-iron sword-stands in the churches of the city of London. These sword-stands, of which two leading and various subordinate types were described, appear to have come into fashion in the reign of Queen Elizabeth; but only one or two of the older ones survived the great fire, and most of those now existing are of the eighteenth century.

PROF. PUTNAM announced, at the last meeting of the American Association, that the Government of Honduras had granted to the museum at Cambridge, Mass., the exclusive right to explore the scientific resources of the country for a period of ten years.

A PAPER by Prof. A. N. Krassnof, read at the meeting of the Geological Society of America, traced the resemblance of the black soils of the Russian steppes and the prairies of America to their similar origin in the layers of successive annual crops of plants.

As described by Charles B. Thwing, the results obtained with Lippman's process for color photography, though not conclusive at all points, seem to indicate that the mixed colors may be reproduced with some fair degree of accuracy. Modifications are introduced by a change of thickness of the film between exposure and final drying, and by a shortening of the distance between maxima caused by the rays striking the reflector at an angle other than the normal. A second result is that an exposure long enough to give a clear image of the red is certain to obliterate the blue by over-exposure; and a third, that an over-exposure may completely reverse the colors, causing the original colors to appear on the reverse and the complementary on the film side of the plate.

PROF. JASTROW describes some curious tests which he made with a young man who had been born without the sense of smell, for the purpose of determining what things are tasted when we eat and what are smelled. It appears that many things which we relish are not tasted, but only smelled.

A PAPER by Mr. John Watson, of Manchester, England, asserts that the redevelopment of lost limbs is not unusual among insects. He has had three specimens in which limbs have been redeveloped, and one case of complete cicatrization. "Redevelopment," he says, "can take place either in the larval or the pupal stage of an insect's metamorphosis."

OBITUARY NOTES.

MR. WILLIAM FERRELL, an American meteorologist of world-wide reputation, died in Kansas City, Mo., September 18th, about seventy-four years old. He was graduated from Bethany College in 1844, became assistant in the American Ephemeries and Nautical Almanac in 1857, and held the place for ten years; was then appointed on the staff of the United States Coast Survey, when he invented the machine for predicting the maxima and minima of tides; was made assistant, with the rank of professor, in the Signal-Service Bureau in 1882; and retired from that position in 1886 to make his home in Kansas City. He published many works, large and small, of researches on the tides or pertaining to meteorological problems; a volume on Recent Advances in Meteorology (1883); a Popular Treatise on the Winds in 1889; and contributions to scientific journals and societies on such topics as thermal radiation, cyclones, tornadoes, and related subjects of terrestrial physics. His earliest scientific writings were contributed in 1856 to the Nashville Journal of Medicine and Surgery. He was a member of the National Academy of Sciences, and an honorary member of the meteorological societies of England, Germany, and Austria.

PROF. MARTIN DUNCAN, F. R. S., whose death has been recently announced, was a special student of fossil corals and echinoderms, and published some valuable memoirs upon them. He was for a long time Professor of Geology in King's College, and there published an account of the Madreporia collected during the expedition of the Porcupine, a description of deep-sea and littoral corals from the Atlantic and Indian Oceans, and a revision of the Echnoidea. He also published many popular articles, including Corals and their Polyps, Studies among Amœbæ, Notes on the Ophiurans, or the Sand and Brittle Stars, and a book on the Sea-shore in the Natural History Rambles series of the Society for Promoting Christian Knowledge.

THE death, by apoplexy, is announced of Dr. L. Just, Professor of Botany at the Polytechnicum, Carlsruhe, Director of the Botanic Garden there, and editor of the Botanischer Jahresbericht.

DR. FRANCIS BRUNNOW, an astronomer equally distinguished in America and Europe, has recently died in Heidelberg, Germany, in his sixty-seventh year. He was associated with Encke in Berlin, and there had a part in the discovery of Neptune. He investigated the motion of De Vico's comet of short period, which, however, has never been seen since. He also, at Berlin and Ann Arbor, Mich., where he became director of the observatory in 1854, calculated the theory of some of the minor planets. He published at Ann Arbor a periodical, Astronomical Notices, which is now very rare. His Lehrbuch der spherischen Astronomie has passed through several editions. He was appointed Professor of Astronomy in the University of Dublin and Director of the Dunsink Observatory in 1865. Retiring from those positions in 1874, he lived the rest of his life in private.

DR. BARCLAY, who recently died in Simla, India, was a specialist in cryptogamic botany, and had acquired an extended reputation by his researches in the diseases of Indian plants He was engaged at the time of his death with the commission for the investigation of leprosy.